

Model Similarity Effects on Motor Performance

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This experiment extended previous findings on whether model characteristics affect attentional subprocesses and mediate performance changes in an observational learning setting. College women ($N = 75$) were randomly assigned to groups in a 2×2 (Cueing by Model Similarity) factorial design or to a no-model control group. To assess attentional differences, subjects were cued either prior to or subsequent to a demonstration as to model characteristics, and model similarity was manipulated by having subjects view a similar or dissimilar model. All subjects saw the same videotaped demonstration, only their perceptions of model characteristics were manipulated. Subjects performed 20 performance trials in Phase 1 with outcome knowledge of results (KR) and, after a 1-min rest period, were given 10 more performance trials without KR in Phase 2. The results from Phase 1 indicated that subjects performed better after watching a model they perceived to be similar than after one they perceived as dissimilar. Phase 2 data indicated that all subjects were performing similarly in terms of outcome scores but that the control group was using a different strategy than the demonstration groups. The investigation found support for performance differences dependent on model characteristics and pointed to the need to examine more than outcome scores when assessing observational learning effects.

Modeling or providing learners with a demonstration is one technique that is fairly well accepted as a means of imparting relevant information to learners in many settings. Although a number of theoretical explanations have been posed to account for the acquisition and production of modeled acts, Bandura's (1969) mediational-contiguity theory has received the widest acclaim in the motor performance literature.

According to Bandura's theory, four subprocesses are presumed to influence the acquisition and production of responses. Attentional and retentional subprocesses are hypothesized to influence acquisition, and motor reproduction and motivation are hypothesized to influence performance. Furthermore, certain variables are presumed to influence each of these subprocesses. For example, model characteristics are presumed to influence attention, stimulus characteristics such as rate

and temporal distribution are hypothesized to influence retention, motor reproduction depends for many skills on practice, and incentive and reinforcement contingencies influence motivation. The primary purpose of this investigation was to examine the role of model characteristics in an observational learning setting.

Recently, model characteristics manipulations have been combined with efficacy manipulations to enhance motor skill acquisition (e.g., Gould & Weiss, 1981; McAuley, 1985). In an attempt to test Bandura's (1977) efficacy predictions, Gould and Weiss (1981) manipulated model similarity and the model's efficacy statements, measuring performance on a muscular endurance task. Subjects viewed either a similar or dissimilar model who made either positive, negative, irrelevant, or no self-efficacy statements. A model-similarity-by-model-self-talk interaction was expected. It was predicted that similar models who made positive efficacy statements would enhance the subjects' efficacy and lead to enhanced performance. On the other hand, dissimilar models who made negative efficacy statements were expected to decrease subject efficacy and cause poorer performance. Performance results indicated that subjects viewing a similar model performed significantly better than subjects viewing either a dissimilar model or no model. The performance results also produced a significant interaction, but the authors concluded that model similarity was more potent than self-talk in modifying performance.

Gould and Weiss (1981), and an earlier study by Landers and Landers (1973) that manipulated model characteristics, both attributed performance differences primarily to motivational factors in opposition to Bandura's prediction that model type would primarily influence attention. To test Bandura's predictions, McCullagh (1986) tested the notion of whether model type affected the attention phase of observational learning. Subjects were cued either prior to or after the demonstration that the model was of high or low status. If model status affects the attention phase as predicted by Bandura, then subjects in the precued high status condition would be expected to differentially focus more attention on this model, as compared to a low status model, and performance would be enhanced. In the postcued condition, subjects were unaware of model status until after the demonstration, and performance differences would not be expected if model status was primarily an attention-controlling variable since the attentional phase would already have been completed. Performance results indicated that subjects performed better after viewing a high as opposed to a low status model.

Contrary to predictions, the cueing manipulation produced no significant performance effects, suggesting that model characteristics did not exert prime influence on the attentional phase, at least as assessed in that investigation. A second purpose in the experiment was to determine if model characteristics had long-lasting effects influencing amount learned or whether the effects were rather transient and affected only performance. By adding a second phase in which subjects were offered an incentive to perform maximally, it was presumed that a learning-performance distinction could be made. The similar performance of all subjects in Phase 2 suggested that performance but not learning was affected.

The purpose of the present experiment was to replicate and extend the findings of previous model characteristic studies (Gould & Weiss, 1981; Landers & Landers, 1973; McCullagh, 1986) and determine if model characteristics affect attentional subprocesses. The experiment manipulated the type of model (simi-

lar or dissimilar) and time of model cueing (pre- or postdemonstration) in an attempt to determine if model characteristics affect the attentional phase of observational learning. In the precued condition, subjects were informed about the model's characteristics prior to watching the demonstration. In the postcued condition subjects watched the demonstration and were then informed about the model's characteristics. In the precued condition subjects could differentially focus their attention on similar and dissimilar models. If model characteristics do influence attention, then this manipulation would be expected to lead to different performance levels. In the postcued condition, subjects first watched the demonstration and were then cued on model characteristics. Performance differences would not be expected between similar and dissimilar models in this condition, if indeed model characteristics influence the attentional phase of observational learning, since the opportunity to differentially focus attention had already occurred.

Additional refinements of previous manipulations were included in the present investigation. The experiment by Gould and Weiss had used a female and a male model to produce the similar and dissimilar manipulations for female subjects who were to perform on a muscular endurance task. Subjects performed worse after viewing a dissimilar male model than after viewing a similar female model. The poorer performance in the dissimilar condition may have been due to having a male model demonstrate a muscular endurance task to female subjects. The low performance expectations for these subjects may have occurred because subjects viewed the task as gender inappropriate. To overcome this shortcoming, female subjects in the present experiment viewed a female model and were led to believe that the model was either similar or dissimilar to themselves. All subjects saw the same filmed model, but their perceptions of similarity were varied. Since the task employed by Gould and Weiss "required all-out effort and very little learning" (p. 28), it may be that the demonstration provided little task-relevant information but instead merely served as a performance standard that influenced subjects' expectations. Therefore the present study used a task that had previously shown improvement over trials (Feltz & Landers, 1977) when compared to a no-demonstration control. (The endurance task used by Gould and Weiss had shown a decrement.)

A final refinement involved the dependent measures employed. The previous experiment by McCullagh (1986) failed to find an attentional effect dependent on model characteristics when attentional differences were inferred from physical performance outcome scores on the Bachman ladder. However, it may be that outcome scores are not as sensitive to modeling manipulations as form or strategy components of the task. Using the same task, Feltz (1982) measured five form components as well as outcome scores and found that climbing quickly as measured by judges' ratings was more sensitive to modeling effects than the typically used performance outcome scores. Therefore, in line with the suggestion of Scully and Newell (1985) that movement components as well as outcome be measured, and in light of the Feltz (1982) findings, the present investigation assessed both outcome scores (height climbed) and form or strategy scores (time spent climbing) as measures of Bachman ladder performance. It was also of interest to determine if model characteristics had a rather enduring effect on performance or whether the effects were rather transient. A second phase of the

experiment with subjects receiving no augmented performance outcome scores attempted to make this distinction, although it should be recognized that outcome scores are inherent in the task employed.

Method

Subjects, Apparatus, and Design

Undergraduate females ($N = 75$) were recruited from the psychology subject pool and received course credit for participation. Fifteen subjects were assigned to each treatment on a rotating basis depending on when they arrived at the experiment. All signed an informed consent before participation.

The task employed was a Bachman ladder (Bachman, 1961), chosen because of its use in previous modeling studies. In addition to the typical outcome scores, an additional dependent measure of form or strategy was employed. Instead of relying on judges' ratings to assess the form component of climbing quickly, the present investigation measured actual time climbing. Subjects performed discrete trials and were given the instruction to climb as high up the ladder as possible on each trial.

The design was a $2 \times 2 \times 4$ (Model Type $\times$ Cueing $\times$ Trials Blocks) factorial design. The first two variables were between-subject factors and the trial blocks was a repeated measures within-subject factor. There were two levels of model type (similar and dissimilar) and two levels of cueing (pre and post). In addition, there was an external control group of 15 subjects who did not receive a demonstration. Subjects were tested individually. Trials were blocked into groups of five.

Phase 1

Upon arriving at the testing room, subjects were seated and read a brief verbal description of the experiment before signing an informed consent. They then received the following taped instructions:

The ladder you seen here is called a Bachman ladder. After observing demonstrations you are going to have a number of chances to climb the ladder. The goal is to balance the ladder in front of you and climb as high up the ladder as possible. In the starting position, the ladder should be held directly in front of you at the edge of the mat. You will place your right foot on the bottom right rung and proceed from there to climb up the ladder. Each rung that the sole of your foot touches will be recorded for height. Do not skip any rungs. Once you lose your balance and your feet touch the floor, that is the end of one trial. You will have 20 trials followed by a 1-minute rest and then will complete a final set of 10 trials. Watch the monitor for demonstrations by Jennifer.

Subjects in the control group received the same verbal instructions and their outcome scores except that no reference was made to the model Jennifer or to demonstrations. After receiving instructions, and demonstrations in the experimental groups, subjects completed a questionnaire that asked about the model

and their perceived similarity to the model, and another questionnaire designed to measure both level and strength of efficacy. Subjects in all groups then received 20 acquisition trials; the experimenter announced outcome scores after each trial.

The Demonstration. Subjects in all experimental groups received the same demonstration by the same model¹ on a black and white video monitor. Only their perception of the model's identity was varied. The model, a young woman, demonstrated the skill 3 times from a side angle and 3 times from a front angle. This sequence was repeated for a total of 12 demonstrations. On each trial the model scored between 5 and 9. The average score was 6.8. The model started with the ladder held far out in front and pulled it toward her as she quickly climbed the ladder. The time spent climbing ranged from 1.3 to 2.3 seconds, with an average of 1.6 seconds.

Model Type Manipulation. In the similar (sim) model condition, subjects were told that the model was Jennifer, who had been chosen to demonstrate because she was a college student and had not had previous experience on this type of task. In the dissimilar condition (dis), subjects were told that the demonstrator was Jennifer, a dancer/gymnast who had been chosen to demonstrate because she had a lot of experience in balance type activities.

Cueing Manipulation. In the precued condition (pre), subjects were provided with the similar or dissimilar instructions prior to viewing the demonstrations. In the postcued conditions (post), they viewed the demonstrations and were then provided with the similar or dissimilar instructions.

Phase 2

After performing 20 acquisition trials, subjects received a 1-min rest and were then asked to complete a final 10 trials without outcome knowledge of results (KR). The purpose of Phase 2 was to determine if subjects could maintain their performance without the informational and motivational benefits of KR. Subjects in the control group similarly completed Phase 2 and then received the same demonstration film as the other subjects. Control subjects then received 10 more trials with outcome KR. The purpose of this additional set of trials for control subjects was to determine if performance strategies would be changed after viewing a model.

Results

Phase 1

A $2 \times 2 \times 4$ (Model Similarity $\times$ Cueing $\times$ Trial Blocks) repeated measures ANOVA was used to analyze both outcome scores and timed data. In addition, a control-versus-all-others comparison was made using Dunn's procedure (Kirk, 1968, p. 79).

Outcome Scores. The results revealed that the model similarity, $F(1, 56) = 3.80, p < .05$, trial blocks, $F(3, 168) = 27.17, p < .001$, and Cueing $\times$ Trial Blocks interaction, $F(3, 168) = 3.966, p < .01$, were significant. Inspection of the means indicated that subjects viewing a similar model ($M = 3.6$) performed

¹Thanks to Jennifer Edwards for serving as the model.

better than subjects viewing a dissimilar model ($M = 3.3$). The trial blocks main effect indicated that subjects improved their performance over trials ($M = 2.9, 3.5, 3.5, 3.7$). A Tukey's post hoc test indicated that Trial Block 1 differed significantly from all other blocks. The cueing-by-trial-blocks interaction is depicted in Figure 1. A test of simple effects (Kirk, 1968, p. 290) indicated that the precued group performed better than the postcued group on Trial Block 1. No other differences were significant. A comparison of the control group versus all others indicated that subjects who received no demonstrations ($M = 2.8$) performed significantly worse than pre sim ($M = 3.8$), post sim ($M = 3.4$), and pre dis subjects ($M = 3.3$), but did not differ from the post dis group ($M = 3.2$). (See Figure 2.)

Time Data. The $2 \times 2 \times 4$ ANOVA for the time data (in seconds) produced no significant differences. The control-versus-all-others comparison is displayed in Figure 2 and did produce a significant effect, $p < .01$. Subjects who received no demonstrations climbed slower ($M = 2.8$) than did subjects in the pre sim ($M = 2.3$), post sim ($M = 2.0$), pre dis ($M = 2.1$), and post dis ($M = 2.0$) groups.

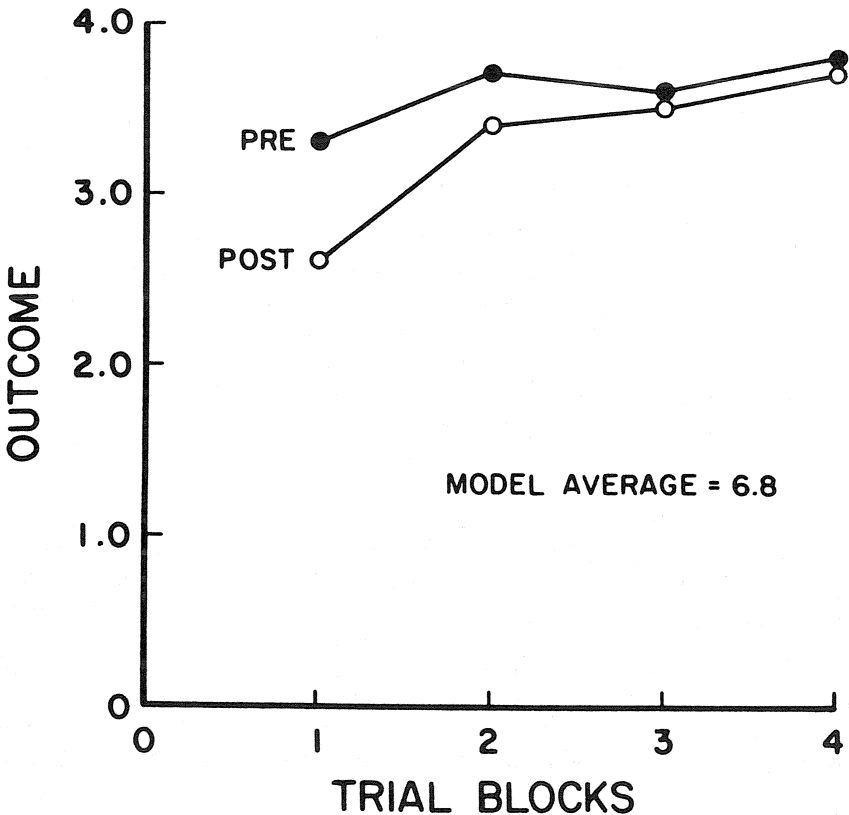


Figure 1 — Cueing by trial blocks interaction for Phase 1.

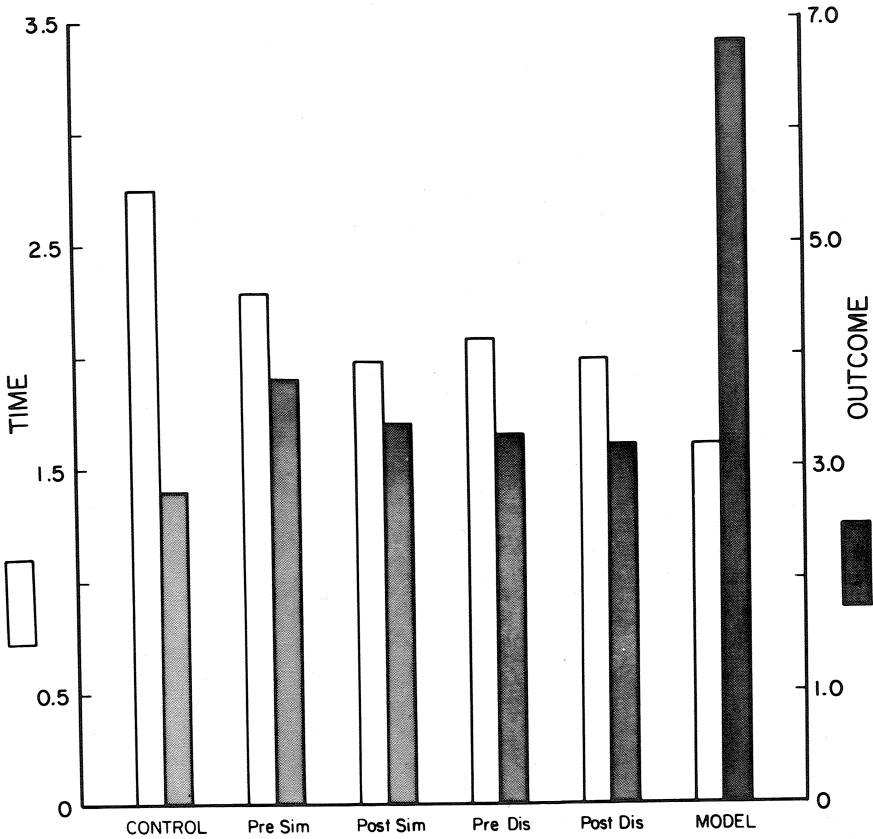


Figure 2 — Phase 1 across all groups.

Phase 2

Phase 2 data were analyzed within a $2 \times 2 \times 2$ (Model Similarity $\times$ Cueing $\times$ Trial Blocks) repeated measures ANOVA for both outcome scores and timed data. In addition, a control-versus-all-others comparison was made using Dunn's procedure.

Outcome Scores. The analysis of outcome scores for Phase 2 produced no significant main effects or interactions. Similarly, the control-versus-all-others comparison produced no significant differences.

Time Data. The $2 \times 2 \times 4$ analysis of variance for time data produced no significant main effects or interactions. The control-versus-all-others analysis did produce a significant effect, $p < .05$, and is displayed in Figure 3. Inspection of the means indicated that subjects in the no-demonstration control ($M = 2.5$) climbed significantly slower than did subjects in the pre sim ($M = 2.0$), pre dis ($M = 2.1$), post sim ($M = 2.1$), and post dis ($M = 2.2$) groups.

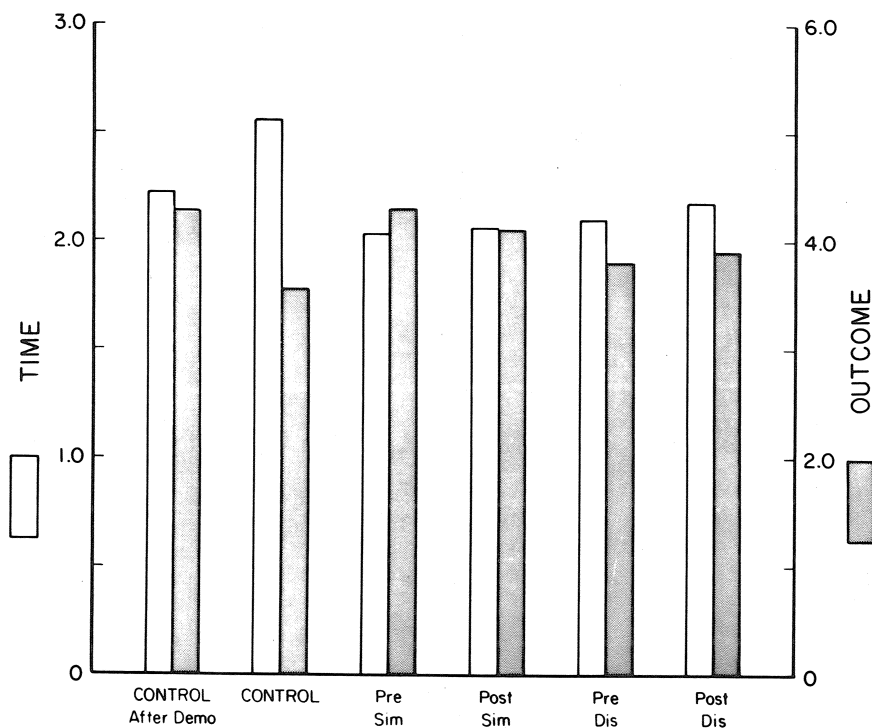


Figure 3 — Phase 2 across all groups.

Control Group Demonstration

After the control group had completed the Phase 2 trials, they were given the same 12 demonstrations as all other groups but were not given any information about the model's identification. The purpose of the manipulation was to determine if subjects would change their strategy as a result of the demonstration. A previous investigation by Landers (1975) had manipulated the temporal spacing of demonstrations and had found that performance was not immediately enhanced by a demonstration when subjects were allowed performance trials and then given a demonstration. To compare Phase 2 data to performance after the demonstration, the mean of Blocks 5 and 6 was compared to the mean of Blocks 7 and 8. A *t* test was performed on both the time and outcome scores. The results indicated a significant difference for outcome scores, $t(14) = 4.86, p < .01$, indicating that control subjects significantly enhanced their outcome performance after receiving a demonstration ($M = 4.3$) and a significant difference, $t(14) = 12.06, p < .01$, for time data indicating that subjects climbed quicker after receiving a demonstration. Figure 3 illustrates this interesting reversal. During Phase 2 the control group was climbing very slowly compared to their outcome scores, but after receiving a demonstration they changed their strategy to climbing much quicker relative to their outcome scores. A second control group who

received no demonstrations but continued trials would be needed to determine unequivocally that modeling produced this apparent change in strategy as opposed to mere practice effects.

Efficacy

Both level and strength of efficacy were measured (Bandura & Adams, 1977). Level of efficacy was assessed by asking subjects to respond yes or no as to whether they could attain rungs 1 to 15, and the number of yes responses was summed. Strength of efficacy was measured on a 100% scale with 10% increments, and strength was calculated by summing the magnitude of the yes responses and dividing this by the number of questions, 15. A one-way ANOVA for all five groups was completed for both level, $F = 1.14$, $p > .05$, and strength, $F = 1.09$, $p > .05$, scores and produced no significant group differences. In addition to group comparisons, correlation coefficients were calculated between level and strength-of-efficacy scores and acquisition-outcome-performance scores.² These correlations are displayed in Table 1.

Table 1
Efficacy Scores and Performance Efficacy Correlations*

	Level		Strength	
	<i>M</i>	<i>r</i>	<i>M</i>	<i>r</i>
Sim - pre	7.7	-.15	39.29	-.09
- post	7.2	.35	36.18	.13
Dis - pre	6.7	.12	41.29	.36
- post	6.3	.13	33.79	.27
Control - no dem.	6.7	.23	31.65	.30

*Correlations are with acquisition outcome scores; none of the correlations were significant.

Questionnaire Manipulation Check

To determine if the similar/dissimilar model manipulation had been effective, subjects in the experimental groups were asked to rate on a 7-point scale how dissimilar (1) or similar (7) the demonstrator was to themselves. Subjects in the pre sim ($M = 4.8$) and post sim ($M = 4.5$) rated the demonstrator as more similar than did subjects in the pre dis ($M = 3.1$) or post dis ($M = 2.9$) groups, thereby substantiating that the model manipulation had varied the subject's perceptions of similarity.

²The correlations between efficacy and initial performance trials are also of interest since practice over trials may have altered self-efficacy. These correlations were calculated and were similarly low.

Discussion

The findings from the initial performance outcome scores replicated previous modeling studies (e.g., Gould & Weiss, 1981; Landers & Landers, 1973; McCullagh, 1986) since the model type manipulation did cause performance changes. When subjects viewed what they perceived as a similar model, they performed better than if they perceived the model to be dissimilar. It really does make a difference who subjects perceive as a model, at least for initial outcome scores. Comparison of the experimental groups with the control group, in terms of outcome scores, indicated that control subjects were performing worse than all but one of the experimental groups during Phase 1. These findings illustrate the importance of providing learners of a novel motor skill with a demonstration if initial enhancement of motor performance is the goal.

Inspection of the Phase 2 data indicated that the groups continued to improve their performance, but there were no differences between any of the groups as measured by outcome scores. This finding suggests, perhaps, that subjects who view a demonstration use the model's performance as a goal upon which to emulate their own performance immediately; but if given adequate practice, no-demonstration subjects can acquire this particular skill and achieve the same outcome without the benefit of a model. In many motor skills, however, the form or strategy of the skill may be important in addition to the outcome. Inspection of the time data presumed to reflect strategy (Feltz, 1982) indicated that during Phase 1 the control subjects were climbing slower than the demonstration subjects, and this difference remained throughout Phase 2. Although control subjects were achieving the outcome, they were not performing the skill in the correct or demonstrated manner. These findings lend further support to the suggestion of Scully and Newell (1985), that more than outcome scores should be assessed since the outcome may be achieved rather quickly but the relative body motions may be incorrect.

The cueing manipulation was designed to determine if model characteristics would affect the attentional phase of observational learning. The significant cueing-by-blocks interaction for Phase 1 outcome scores suggests that precued subjects had better initial performance than postcued subjects, regardless of whether the model was similar or dissimilar. This finding suggests that attention may have been differentially focused when subjects were precued on model characteristics and resulted in performance differences, but does not support Bandura's prediction that model characteristics affect the attentional phase of modeling. It may be that subjects exhibit differential performance levels as a result of different motivational levels. From the present data it is difficult to make this distinction.

An interesting finding in the present investigation was the change in strategy by control subjects once they were given a demonstration. Before seeing a demonstration, the control subjects were not displaying the desired form or strategy of climbing quickly. However, upon viewing a demonstration they enhanced their outcome scores significantly and changed their strategy as they started climbing significantly quicker. This finding is somewhat contradictory to earlier findings by Landers (1975) which indicated that subjects who received a demonstration after 15 practice trials did not immediately enhance their performance. However, only outcome scores were assessed in that investigation, whereas findings in the present investigation and in the Feltz (1982) investigation suggest that some components of form may be more sensitive to modeling manipulations.

The present investigation found no significant relationships between either level or strength of efficacy and performance. This finding seems contrary to those reported by Gould and Weiss (1981), who did find significant correlations between efficacy level and performance for subjects in both similar and dissimilar model conditions. However, these correlations were only significant in the positive model self-talk conditions. When the present efficacy correlations are compared to the no-model talk conditions in the Gould and Weiss study, which more closely resembles the manipulations employed here, the correlations in both studies are in fact similarly low. A closer examination of the data indicates that subjects in both studies had high expectations but performance did not meet these expectations. In the present study, subjects in all groups predicted they could reach rung 6 or 7 on the ladder, but on the average they only reached rung 2, 3, or 4. Similarly, in the Gould and Weiss study subjects were predicting that they could perform for over 100 seconds in many of the conditions, when in fact performances were in the range of 40 to 69 seconds. Considering the discrepancy between what subjects think they can do and what they actually do, it is not surprising that the correlations are low.

The present investigation replicated previous findings by showing differential performance dependent on model characteristics. For outcome scores this manipulation had an immediate effect on performance, but control-group subjects who physically practiced without the benefit of a demonstration were able to achieve the same level of performance in just a few trials. However, when the strategy of acquiring the skill was assessed, the benefits of modeling were more evident. The lack of a persistent cueing effect has two possible interpretations. Either model characteristics do not influence the attentional phase, or the dependent measures employed were not sensitive to this manipulation. In line with the suggestion of Scully and Newell (1985), the present investigation points to the need of focusing not only on outcome scores but also on dependent measures that more adequately assess the movement form or strategy. Martens, Burwitz, and Zuckerman (1976) demonstrated this point when they assessed the strategy used by subjects in various modeling conditions. Outcome performance scores may not reflect strategies.

The present study may suggest that providing demonstrations for this particular task does not seem to be extremely advantageous since the beneficial effects of various modeling manipulations dissipates after only a very few practice trials, and in fact no-demonstration subjects quickly reach the performance level of modeling subjects. However, further considerations seem necessary. It may be that through modeling one acquires the cognitive components of the task but that skilled execution requires practice and feedback. Such effects may be similar to those reported in the mental practice literature wherein greater facilitatory mental practice effects are found on cognitive tasks than on motor tasks (see Feltz & Landers, 1983, p. 45). Another consideration in this study and previous ones employing the same task, as well as investigations using different tasks (e.g., Ross, Bird, Doody, & Zoeller, 1985), is that subjects have either received augmented knowledge of results about their performance or the task implicitly supplied them with unambiguous information about their own performance. Considering the potency of KR in altering motor performance (see Salmoni, Schmidt, & Walter, 1984, for a review), it would seem necessary to examine the strength of modeling when subjects are not provided with this error information (e.g., Newell, 1976). The issue centers on whether subjects can construct

as accurate a cognitive representation when information is provided prior to action (modeling) as when information is provided subsequent to action.

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Manuscript submitted: September 22, 1986

Revision received: April 8, 1987