Modeling and Motor Skill Acquisition

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This paper reviews the psychological and motor performance modeling literature to identify important factors involved in and affecting the modeling process as it relates to motor skill acquisition. Topics discussed include modeling theory, task specificity of modeling effects, the importance of symbolic coding, temporal spacing of demonstrations, social factors influencing modeling, and the role of modeling in reducing anxiety when unfamiliar motor activities are learned. Future research directions are discussed and implications for physical educators and coaches who employ modeling as an instructional technique are outlined.

Social learning theorists consider imitation or modeling to be one of the primary means by which individuals are socialized into the culture within which they exist. The learning of values, skills, attitudes, and in general, most culturally determined patterns of behavior are acquired through the imitation or modeling process. In addition to being recognized as an important means of societal socialization in general, modeling through demonstration enjoys wide acceptance as a teaching technique in sport and physical education. Whenever a teacher or coach wishes to modify the already learned responses of a student or athlete or wishes to communicate a new response, he or she resorts to modeling techniques. Yet, despite its widespread use and acceptance in the teaching profession, the psychological process of modeling is poorly understood. Therefore, the present review presents a brief overview of pertinent theories and relevant findings of the psychological and physical education modeling literature, focusing upon the important factors involved in and affecting the modeling process as it relates to motor skill acquisition. An understanding of the factors involved in the modeling process will aid the physical educator and coach to more effectively employ modeling and demonstration techniques in the gymnasium and on the athletic field.

Before we review the literature, however, we need to define our domain of concern. This review is primarily concerned with the process whereby an observer reproduces, or attempts to reproduce, the actions exhibited by another person, the model. Thus, the focus of this review is on demonstrations as a form of instruction; we will not deal with what may be labeled self-modeling, which is a process by which individuals receive feedback about their own perfor-
performance via film or videotape devices. Such self-modeling processes are more appropriately considered under rubrics such as knowledge of results or feedback.

Over the years, many terms have been used to refer to the behavioral changes that result from an observer's exposure to another person's performance of a cognitive or motor act. Bandura (1965), however, has questioned the lack of parsimony which arises when such minor distinctions between terms are made because essentially the same learning process is involved. Therefore, in the present review, terms such as demonstration, imitation, observational learning, modeling, and vicarious learning will be used synonymously to refer to a general process whereby an observer reproduces the overt actions exhibited by a model (either a real life model or a model symbolized through film or video tape), regardless of whether the responses are novel and thus newly acquired, or are modified versions of existing response repertoires within the observer. Thus, many forms of modeling can frequently be observed in physical education and athletic environments. For example, an informal type of modeling occurs in situations where a child attempts to copy or model the style of play of his or her favorite sports figure, whereas a more structured type of modeling occurs in teacher-student or coach-player instructional settings where an athlete or pupil attempts to replicate a selected skill that was previously demonstrated by his or her coach or instructor.

The amount of space that physical education method texts devote to demonstrations and their usage further reflects the strong emphasis the field places upon the modeling process. Similarly, organizations such as The Athletic Institute produce and sell a wide variety of films and film loops based upon the modeling of sports skills. Consequently, it comes as no surprise that in the past, physical educators have investigated the effect of viewing a live or filmed model on sports skill acquisition (Brown & Messersmith, 1948; Gray & Brumbach, 1967; Lockhart, 1944; Nelson, 1958). These studies have typically examined the effect of demonstrations upon certain selected sport skills such as tumbling, badminton, swimming, and bowling. A review of the results, however, reveals that no consistent conclusions may be drawn from these investigations. Some studies support modeling procedures (Gray & Brumbach, 1967; Lockhart, 1944), some studies do not (Brown & Messersmith, 1948; Nelson, 1958).

The difficulty in integrating these divergent findings has arisen, in part, because of methodological problems inherent in some of these investigations. Problems such as inadequate sample sizes, invalid evaluation procedures, possible social facilitation effects, lack of adequate controls, and the failure to demonstrate homogeneous ability levels between experimental and control groups has confounded the results and, in turn, hindered the interpretation of many of these investigations. A second major difficulty with the sport skill modeling research results from its atheoretical nature. In essence, the majority of the investigations are applied in nature and were not designed to test existing or develop new modeling theory. Thus, the generalizability of these findings are limited to the environments in which they were tested. These experiments were also conducted in relative isolation from one another (rather than being a part of a systematic series of experiments), causing additional difficulties in interpreting many of their findings. Therefore, to alleviate many of these difficulties, this review will focus primary attention upon the modeling and motor skill acquisition research that is theoretically based and systematic in nature.
Modeling Theory

The majority of observational learning research has been conducted in the last two decades. It would be a misconception, however, to think that the modeling process has been ignored by psychologists in the past, for the study of imitation has a history dating back to the early work of Tarde (1903) and McDougall (1908). These investigators suggested that modeling was a basic instinct, as was characteristic of the social philosophical nature of the field at this time, but seldom, if ever, did they empirically test this assumption. Later, imitation was reinterpreted as a function of associative or instrumental conditioning (Allport, 1924; Holt, 1931; Humphrey, 1921; Miller & Dollard, 1941) or from a developmental perspective (Guillaume, 1926/1971; Piaget, 1951). Of these theories, however, only the work of Miller and Dollard was founded on a systematic data base. Yet little modeling and motor skills research was generated to test Miller and Dollard’s predictions and the modeling-motor performance relationship remained empirically unexplored.

Sheffield’s Symbolic Representational Theory

The first systematic, long-term research program examining the relationship between motor skill acquisition and modeling was funded by the US government in the years following World War II (published in Lumsdaine, 1961). The overall purpose of this program focused on obtaining a better understanding of methods of programmed instruction. In doing so, psychologist F.D. Sheffield and his associates concentrated the bulk of their research efforts on a more specific problem; the effectiveness of using filmed demonstrations in motor skill acquisition (Sheffield, 1961). Based upon the findings of this research program, Sheffield developed what may be called symbolic representational theory, explaining the modeling process and, more specifically, the effect of filmed demonstrations on complex-serial motor task learning. The symbolic representational theory maintains that when an individual observes a demonstration of a motor skill, he or she formulates a cognitive symbolic representation of that skill, which subsequently acts as a blueprint to guide the overt reproduction of the skill. This perceptual blueprint enables the individual to symbolically recall the modeled act and translate this sequence of perceptual and symbolic cognitions into overt performance.

Sheffield and his associates found that demonstrations facilitated learning but were not sufficient to provide complete learning of a complex motor task. It came as no surprise that overt practice was also essential, and consequently, one of the major concerns of Sheffield’s research was to examine what he labeled utilization variables. These variables represent the ways in which demonstrations can be combined with practice intervals for effective learning of motor tasks. A major question addressed by Sheffield was what those in physical education and athletics term the whole versus part problem of motor learning. That is, is it more effective for learning for the model to demonstrate and the learner to practice a motor task as a whole unit or to divide the task into parts for demonstration and practice purposes? The results of Sheffield and his associates failed to reveal an obvious answer because many of the findings depended upon the nature of the task used. It was generally found, however, that the distributed practice method was best to use when one was concerned with complex task performance where many steps of the task had to be remembered. More importantly, Sheffield identified the concepts of natural units and dem-
onstration-assimilation spans (DA spans), which facilitate the process of subdividing tasks into parts when the distributed practice method of modeling is used to learn motor skills.

Natural units are those parts of a sequential task that may be subdivided along natural dimensions inherent in the task itself. Thus, if one were interested in modeling a particular swimming stroke where many task segments must be remembered, the swimming stroke action could be subdivided into natural segments of the kick, arm action, and breathing portions of the stroke. All skills are not easily subdivided into natural units, however, and in such cases it was suggested the task be subdivided along DA spans. DA spans are defined as the largest unit of the perceptual sequence of a task that an individual can store in memory and recall. Thus, according to the DA span approach, the task would be subdivided into parts equivalent to the DA span of the performer. For example, if a young child was learning a gymnastic routine and could not remember the entire sequence of movements comprising the routine, the instructor would divide the skill into DA spans appropriate to the child. The child would then see a demonstration of the first DA span and practice it. Later, after the first DA span was learned, the next DA span would be demonstrated and practiced. This procedure would continue until the child learned the entire routine. If many DA spans had to be learned, the instructor would have the child learn the first DA span, see a demonstration of the first DA span combined with the second DA span, and practice the two combined. This process would continue until all the DA spans had been learned as a unit. It must be recognized, however, that it is difficult to a priori determine the appropriate DA span peculiar to each child. Consequently, in practice, the teacher must intuitively determine the DA spans.

Sheffield and his associates were not only concerned with utilization variables, but they also identified demonstration variables as another important subclass of factors affecting the modeling process. Unlike utilization variables, demonstration variables do not affect performance outcome directly, but rather are concerned with the quality of filmed demonstrations themselves. Based upon the findings of a series of investigations, a number of suggestions about demonstration variables were made in order to improve the clarity of filmed demonstrations. For example, it was suggested that all demonstrations should be constructed so that the model is filmed from the same visual angle as the observer would experience when he or she practiced the skill; close-ups should not be taken without establishing the relationships of the isolated close-up parts of the task to the task as a whole; and all complex demonstrations should be filmed from several different angles.

Despite this important early work by Sheffield and his associates, little theoretically-based applied or basic research has been conducted on the modeling of motor tasks. Therefore, many important questions pertaining to modeling of motor tasks for effective learning remain unanswered. Bandura (1965, 1969, 1974), however, has proposed a stimulus-contiguity theory of modeling which has stimulated a great deal of research on modeling processes.

Bandura's Mediational-Contiguity Theory

Bandura's mediational-contiguity theory is by far the most influential theory of modeling today, although it is not a totally new approach to the area. Rather, Sheffield's contribution to psychological modeling literature remains intact as symbolic representational theory
Four Subprocesses of Bandura’s Mediational-Contiguity Theory of Modeling

Table 1

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<th>Subprocess</th>
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<td>Attention</td>
<td>Response acquisition phase</td>
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<td>Retention</td>
<td>Performance reproduction phase</td>
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has been incorporated into and forms the foundation of Bandura’s theory. The basic assumption of Bandura’s theory of modeling is similar to that of Sheffield’s earlier theory in that “modeling influences operate principally through their informative function; and that observers acquire mainly symbolic representation of modeled events, rather than specific stimulus response associations” (Bandura, 1974, p. 16). Thus, both Bandura and Sheffield believed that as an observer views a modeled demonstration, he or she symbolically or verbally codes the modeled (observed) response and stores this response in memory. Later, when the appropriate environmental cues are presented, the observer recalls the symbolically or verbally coded response and uses it to guide overt performance. In essence, Bandura subdivides the modeling process into two distinct phases: a response acquisition phase of modeling and a performance reproduction phase of modeling. The response acquisition phase of modeling is concerned with the process whereby the observer covertly codes and rehearses the modeled response, whereas the performance-reproduction modeling phase focuses on the process of using the covertly coded response to guide overt performance.

Bandura (1974) further specifies his mediational-contiguity theory of modeling by organizing the modeling process into four subprocesses (see Table 1). The response acquisition phase of observational learning is divided into the attention and retention subprocesses whereas the performance-reproduction phase is divided into the motor reproduction and motivational subprocesses. The attention subprocess is elemental in that the observer must attend to, recognize, and discriminate between the distinctive features of the modeled act. The retention subprocess is concerned with the symbolic or verbal coding of the observed act which is essential for learning to occur. Factors such as verbal rehearsal, symbolic labeling, and cognitive organization in general have been found to play an important role in the retention subprocess (Bandura, 1974). Motor reproduction is an important subprocess of the performance phase of modeling because if the observer does not have the motor capability to reproduce the coded act, reproduction of the observed response will not be possible. For example, a young boy may possess the covert symbolic code, or blueprint, of how to put a shot, but it may be impossible for him to perform this act because he does not possess the physical strength to do so. Although the first three subprocesses may have been successfully completed, it
is still possible that the modeled act may not be reproduced because the observer has no incentive to do so. For example, a child may know how to perform a sport skill, but may not overtly perform the skill because there is no motivation to do so. Thus, the motivation subprocess focuses on the conditions which motivate the observer to reproduce the modeled response, such as extrinsic reinforcement, self-reinforcement, and vicarious reinforcement techniques. In general, a great deal of support has been obtained for Bandura’s theory of modeling, as shown in the number of reviews on the topic (Bandura, 1965, 1969, 1974).

Motor Performance Research

Testing Bandura’s Predictions

Despite the importance of Bandura and Sheffield’s theoretical work, few physical educators have shown interest in it. Recently, however, investigators in the area of physical education, sport psychology, and motor performance have been attempting to generate theoretical and empirical interest in the topic of modeling and motor skill acquisition. Typically, these researchers have applied and tested Bandura’s theoretical contentions in motor performance situations. In a series of investigations, for example, Burwitz (Note 1) examined the effects of whether information gained from a model demonstrating task performance influences the observer’s subsequent performance on the same task. In the first experiment a mixed group of undergraduate college students were asked to perform eight trials on a Bachman ladder task after receiving either a live demonstration or no demonstration at all. Similarly, in the second experiment another group of subjects performed eight 20-second trials on a pursuit rotor task after viewing a live demonstration or no demonstration. The results of these two experiments revealed that a modeling effect was found for the Bachman ladder task, but no differences existed between the two conditions on the pursuit rotor performance. Burwitz (Note 1) indicates that the discrepancies in the findings occurred because only on the Bachman ladder demonstration were the cues governing correct task performance visible to the observer. Thus, this interpretation supports Bandura’s (1974) contention that stimulus discrimination (clarity of cues governing correct performance) is an important prerequisite to observational learning.

Martens, Burwitz, and Zuckerman (1976) conducted another series of experiments to determine the role of demonstrations in the learning of motor tasks. More specifically, the primary objective of this investigation was to test Bandura’s hypothesis that the observation of a model (a demonstration) conveys task-relevant information to the observer and that this information facilitates the observer’s subsequent task performance. In their first experiment, male subjects learned a ball roll-up task after viewing a film of a model either performing the task correctly, incorrectly, or in a progressive learning sequence (moving from incorrect to correct task performance). These three modeling conditions were compared to a control condition, where the subjects did not view a filmed demonstration before performing 50 trials on the ball roll-up task. Data analysis over trials revealed that both the learning sequence model and correct model groups performed significantly better than the control group only on the initial 10 trials of this simple task. Thus, it was concluded that modeling only facilitated early task performance.

A second experiment was conducted in an attempt to determine why the modeling effects occurred only in the early
trials of the ball roll-up task. In this experiment, the same task and conditions were used except that all the subjects also viewed a second film where the model demonstrated task performance but the results of the model's performance were not shown until after each subject estimated the outcome of each trial. After completing 10 actual trials at the task, all subjects were again asked to estimate the performance outcome of a filmed model. Figure 1 illustrates the results which revealed that the correct model and learning sequence model groups exhibited reliably better initial estimates of performance compared to the control group. After performing 10 trials on the task (test two), however, no reliable differences between the experimental and control groups remained. It was concluded that the correct model and learning sequence model groups gained task-relevant information from the modeled performance which facilitated initial task performance. Practice on this simple task, however, obviously conveyed the same information to the subjects in the other conditions which led to equivalent levels of task-relevant information.

Although Experiments 1 and 2 examined the effects of information conveyed
by a filmed model on the performance of a low-cognitive demand task, Experiment 3 used the same four conditions but had male college students perform 12 blocks of five trials on a task with a higher cognitive demand. The task was a "shoot the moon game" and was selected because two definite performance strategies can be used. One strategy, the "creep strategy," was an inappropriate means of obtaining an extremely high score on the task (e.g., 8), but was a reliable method for obtaining lower scores (e.g., 3 or 4). In contrast to the "creep strategy," a more explosive strategy that made the highest scores possible could be used. This strategy was the riskier of the two, however, because low scores often result (e.g., 0 or 1). The investigators defined the creep strategy as incorrect and the explosive strategy as correct. Contrary to what was predicted, the results indicated that the incorrect model and control groups performed significantly better than the correct model group. Subsequent analysis, however, revealed that the learning sequence model group and the correct model group received a higher percentage of perfect 8 scores. Thus, subjects in the correct model and learning sequence model condition modeled the more variable, riskier "explosive strategy." This resulted in lower mean scores (but a higher percentage of perfect 8 scores) because of the greater difficulty in consistently employing the explosive strategy.

Experiment 4 was an extension of Experiment 3 and examined the effects of a filmed versus live model. Twelve additional subjects were drawn from the same population and tested after viewing a live model. This group was then compared to the correct model and learning sequence model conditions of Experiment 3. Results revealed that no significant differences occurred in the performance of subjects viewing the live and filmed models.

The investigations by Burwitz and by Martens, Burwitz, and Zuckerman are both theoretically based and systematic in their approach. The findings are important in that they demonstrate that modeling procedures are an objective means of conveying pertinent information to observers in order that they learn motor skills more efficaciously. The findings also provide some support for Sheffield’s early contentions that modeling effects are to a large extent dependent upon the nature of the task being used.

Task Specificity of Modeling Effects

The specificity of the modeling-motor task-type relationship was directly examined in a recent series of experiments conducted by Gould (1978). Three independent experiments were conducted, each consisting of a simple Sex by Model/No Model by Trials design, with a different motor task being used in each experiment. The three tasks used were a rebound-ball-roll-accuracy task, a geometric-construction-assembly task, and a speed-of-movement-ball-snatch task. These laboratory tasks were selected because they were either similar to existing athletic skills, dissimilar to other tasks studied by modeling researchers, or very similar to tasks on which modeling had little or equivocal effects in the past. In all three experiments the same model was used, and all procedures and treatments were standardized.

The results revealed that modeling clearly did not facilitate performance on the ball-roll-accuracy task, modeling clearly did facilitate performance on the geometric-construction-assembly task, and modeling facilitated ball-snatch task movement-time performance, but only for the male subjects. These results directly demonstrated that the effect of observing a model on motor skill acquisition is task specific. The task type be-
ing learned is therefore an important consideration when conducting and interpreting modeling research. The findings of a follow-up task classification survey also revealed that information load and component-movement novelty are two task properties that appear to influence model effectiveness. Specifically, the higher the information load of a task (e.g., the greater the number of procedural steps that must be remembered or the greater the degree that a particular strategy is involved), the more susceptible the task will be to modeling effects. In contrast, the greater the component-movement novelty of the task (e.g., the greater the difficulty of the component movements comprising the task), the less susceptible the task will be to modeling influences. Unfortunately, the design of this investigation did not permit causal relationships to be made between these task properties and model effectiveness, and the results can be viewed only as suggestive. Therefore, further research is needed to identify and examine key task properties related to model effectiveness.

Symbolic Coding

The experiments reviewed above have firmly established that modeling conveys task-relevant information such that observers were able to learn motor skills more effectively. Having established the efficacy of modeling, a reasonable question to ask is how may we maximize the modeling process for effective learning? One process which appears to affect observational learning is the symbolic coding operations employed by the observer.

Gerst (1971) found that symbolic coding operations play an important role in observational learning. Gerst investigated several procedures by which individuals could commit to memory a demonstration of a motor task. Subjects were instructed to either use a mental image of the modeled act, to verbally describe the modeled act to themselves, or to use a concise label of the modeled act (similar to a mnemonic code). Gerst also used a control group that was given no coding strategy instructions. The modeled acts were certain symbols used by deaf people to communicate to each other. The results indicated that subjects who used concise labeling strategies were able to reproduce approximately twice as many of the modeled motor responses as the other conditions. Consequently, it is obvious that those researchers interested in the relationship between modeling and motor skill acquisition need to examine the relationships between and the effectiveness of different types of coding operations.

Two investigators (Jeffery, 1976; Pomeroy, 1975) recently conducted studies examining the role of specific types of coding and rehearsal operations in the modeling-motor performance relationship. In an investigation by Pomeroy (1975), three treatment groups of educable mentally retarded children (IQ ranging from 55 to 75) were required to learn a motor sequence of jump, step, hop, and turn in a predetermined order. The subjects assigned to the model condition observed two demonstrations of a model performing the movement sequence before they attempted to perform it themselves. In addition to these two initial demonstrations, if the child performed the sequence incorrectly on two subsequent trials another demonstration was shown. This procedure was continued until the child performed the sequence correctly on two successive trials. A second treatment group was labeled the verbal/model condition and was identical to the model conditions with the exception that subjects in this group also received verbal cues. Lastly, a verbal pretraining condition was used in which the children had verbally learned
the predetermined movement sequence beforehand and then attempted to perform the sequence after the investigator repeated it twice. The results revealed that it took fewer trials for the verbal/pretraining and verbal/model conditions to correctly perform the sequence as compared to the children in the model condition. Thus, support was provided for Bandura’s contention that verbal coding or rehearsal facilitates the acquisition of motor skill via modeling techniques.

In another investigation, Jeffery (1976) not only examined the effects of mode of rehearsal on the acquisition and retention of modeled acts, but also varied the nature of the task as well. Subjects observed a filmed model construct two manual construction tasks, one of high and one of low organizational complexity. The low organizational-complexity task was composed of 54 puzzle pieces which, when assembled correctly, formed an eight-component “symmetrical” configuration triangular in shape. Similarly, the high organizational-complexity task also contained 54 puzzle pieces. When correctly assembled, however, the puzzle formed a more complex “asymmetrical,” tower-like object consisting of a number of different components. Immediately after observing the modeled act, the subjects rehearsed the observed activity with either mental images, motor reproduction, mental images followed by motor reproduction, or motor reproduction followed by mental images, or they engaged in an unrelated activity preventing rehearsal. After completing the rehearsal procedures, and another rehearsal 1 week later, all subjects were administered a performance test. The results reflected the influential role that symbolic rehearsal plays in the acquisition and retention of modeled acts, in that subjects who rehearsed the modeled behaviors symbolically (with either mental images or any combination of mental images with motor practice) reproduced both tasks more accurately than subjects who did not rehearse or only rehearsed motorically. Furthermore, the task type was found to play an important role in the modeling-performance relationship. Motor rehearsal facilitated speed on the low organizational-complexity task, but did not enhance response acquisition over observation alone. Interestingly, in the high organizational-complexity task the symbolic rehearsal influenced both speed and accuracy of acquisition, with motor rehearsal having only a limited effect.

The studies by Pomeroy (1975) and Jeffery (1976) demonstrate the important role of coding operations in observational learning. Modeling with coding instructions facilitated motor performance. Yet many critical questions remain unanswered. For example, in both of these studies, the subjects already had the movement patterns necessary for task performance in their response repertoire. Thus, the children in the Pomeroy investigation already knew how to hop, skip, step, and jump, and Jeffery’s subjects could easily conduct the physical aspects of assembling the configuration tasks. In the acquisition of sport skills, however, children do not always have the movement patterns necessary for task completion in their response repertoire and spatial-temporal relationships often must be learned. It is plausible that other modes of coding and rehearsal may be more beneficial in such cases. Consequently, more research needs to be conducted on mode of rehearsal for effective learning and the modeling of different types of motor tasks.

Temporal Spacing of Demonstrations

A second way modeling effects may be maximized is through the use of tem-
temporal spacing of demonstrations. It has been hypothesized (McGuire, 1961; Sheffield, 1961) that for complex tasks a single demonstration may exceed the information-processing capacity of the observer by presenting too much information at too fast a rate. By using repeated demonstrations distributed throughout the practice period, however, the observer is given more time to attend to and code the model stimuli, and thus, performance should improve. Landers (1975) and Thomas, Pierce, and Ridsdale (1978) have examined this question in motor performance settings.

Landers (1975) tested the relationship between temporal spacing of demonstrations and motor performance on a Bachman ladder balance task. Specifically, 180 female subjects observed four demonstrations in one of three conditions: a before-model condition, where the subjects observed the model prior to performing 30 trials on the task; an interspaced-model condition, where two demonstrations were shown prior to performing and two midway through the performance trials; and a middle-model condition, where the four demonstrations were shown midway through the practice trials. In addition, the subjects performed the skill in the presence of the experimenter only, in the presence of the experimenter and the model, or in the presence of the experimenter and a stranger. The results revealed that no significant effects were found for the type of audience present during performance. Partial support for the utility of temporal spacing of demonstrations was found, however, in that the before-model and interspaced-model groups performed better than the middle-model only group on the first block of five trials, and the interspaced-model group exhibited higher performance than the middle model-group on the fourth block of trials. It was suggested that observers viewing the before and interspaced model exhibited superior performance because they were able to form a memory code to guide their performance before actually performing the task, whereas the middle-model subjects could not. However, the prediction that the interspaced model subjects would perform best because they would be able to code some of the cues prior to performing and others midway through their performance was not substantiated.

In another investigation, Thomas, Pierce, and Ridsdale (1977) examined the effects of Age (7-year olds versus 9-year olds) and Temporal Spacing of the Model (beginning, middle, no model) on the stabilometer performance of female subjects. It was found that for both age groups, the beginning model facilitated performance. The middle model had a detrimental effect on the performance of the 7-year olds, however, while it facilitated the performance of the 9-year olds. One explanation given for this Age by Temporal Spacing interaction was the greater information-processing capacity of the 9-year olds. In essence, the increased information-processing capacity of the 9-year olds enabled them to efficiently use the cues gained from both the beginning and middle model. Although the 6-year olds were also able to effectively use the cues gained from the beginning model, they did not have the information-processing capacity to change from their own strategy to the modeled strategy after seeing the middle model.

Thus, although the temporal spacing of the demonstrations has been shown to influence performance, no clear pattern of findings has emerged on what type of spacing is most efficacious. Nevertheless, the results do show that this relationship depends on the developmental level of the learner. Early researchers (McGuire, 1961; Sheffield, 1961) have also suggested that this relationship may
depend on the nature of the task.

**Social Factors Influencing Modeling**

Although much of the research in the area has focused on the type of information conveyed to the observer through demonstration as well as factors influencing model effectiveness, Landers and Landers (1973) examined the relationship between certain social characteristics of the model and the modeling of a motor task. Does the status of the model the observer is watching affect the acquisition of a motor skill? To investigate this question, Landers and Landers had grade school children observe either a highly skilled teacher, a highly skilled peer, an unskilled teacher, or an unskilled peer model perform a complex motor task. The subjects were required to climb as many rungs of the Bachman ladder as possible in each of 30 trials. After observing the modeled performance the children were then asked to perform the task. The results revealed that the children who observed the skilled teacher performed at a higher level than the children who viewed the unskilled teacher or skilled peer. This finding was in complete accord with Bandura’s theory that suggests that observers should more often model and pay closer attention to those individuals who are older, control important resources, are highly skilled, and/or are status confirming (such as a highly skilled teacher). An unexpected and provocative finding in this study was that children who observed an unskilled peer model exhibited better performance than those children who watched an unskilled teacher model. This unexpected finding becomes more plausible when one considers that the unskilled teacher may have set an upper limit of acceptable performance for the children which would not be true of the unskilled peer. In other words, the unskilled teacher set a low standard of performance that was relatively easily matched, which then precluded the subjects from attempting higher levels of performance. This contention is plausible in view of the goal-setting literature (Locke, 1968).

The influence of social factors on modeling was recently demonstrated in an experiment conducted by Gould (1978). In this experiment, a significant Modeling by Subject Sex interaction was found in movement time scores on a speed-of-movement-ball-snatch task. Specifically, the observation of a male model facilitated performance of male subjects, but no modeling effects were found for females. This significant interaction was explained by differences in motivation for the different subject groups. It was suggested that male subjects observing a male model were motivated more than females because the males may have defined “motor” performance as a salient self-evaluative situation, perceiving the male model as a similar other. Thus, the interaction of the sex of the model and the sex of the observer appeared to influence the modeling-motor performance relationship, with similar others more often being modeled and having greater influences than dissimilar others.

A follow-up investigation conducted by Gould and Weiss (1981) provides further support for this contention. Specifically, an experiment was designed to determine if observing a similar or dissimilar model who makes varying self-efficacy (self-confidence) statements influences an observer’s efficacy expectations and, in turn, muscular endurance performance. Female subjects were randomly assigned to groups in a $2 \times 4 \times 3$ (model similarity by model talk by trials) factorial design or to a no-model control group and performed a muscular endurance leg extension task. Model similarity was manipulated by having the subjects view a female described as a nonathlete...
(similar model) or a male described as a varsity track athlete (dissimilar model). The four levels of model talk included: (a) a positive self-talk model who performed and made positive self-efficacy statements, (b) a negative self-talk model who made negative self-efficacy statements, (c) an irrelevant self-talk model who made statements unrelated to self-efficacy, and (d) a no-talk model who remained silent throughout the performance. A model similarity by model-talk interaction was predicted in which observing a similar model make positive self-efficacy statements would increase the subject’s self-efficacy and performance to the greatest degree. In contrast, it was predicted that viewing a dissimilar (superior) model making negative self-statements would result in the poorest performance and lowest efficacy expectations.

The findings generally supported these predictions in that the similar-model subjects extended their legs significantly longer than the dissimilar-model and control subjects. Moreover, the similar-positive-talk and similar-no-talk groups performed significantly better than the dissimilar-positive-talk, dissimilar-negative talk, dissimilar-no-talk, and the no-model control groups. Subject self-efficacy, however, was only found to differ in the predicted directions for the similar- and dissimilar-model groups.

These findings are important for several reasons. First, they support previous modeling research (Bandura, Ross, & Ross, 1963; Brown & Inouye, 1978; Perry & Perry, 1974) and demonstrate the importance that social characteristics of the model (e.g., sex, similarity) have on motor performance. Thus, teachers and coaches must recognize the importance of the model’s social characteristics when demonstrating. Second, the findings demonstrated the need for motor performance researchers to examine the interactive effects of both what models “do” and “say,” because past research has only focused on the visual influences of observing a model. Finally, this evidence shows that modeling may, at times, operate through a motivational, as well as an informational function, in that modeling effects were found on a task that required all-out effort and very little learning. Consequently, modeling is not only an important technique for conveying task-related motor performance information, but may also play an important role in observer motivation.

**Modeling and the Reduction of Anxiety**

The informational role modeling plays in skill acquisition is receiving increased attention in the motor performance literature, but modeling as a means of reducing anxiety has received only scant attention. For example, the anxiety and fear associated with learning unfamiliar activities is often a problem in sport-skill instructional settings (e.g., swimming, gymnastics, diving), but only a few investigators (Lewis, 1974; Feliz, Landers, & Raeder, 1979) have explored the possibility of using modeling to reduce anxiety in these situations. Despite the paucity of research in this area, the few studies that have been conducted have shown promising results.

Lewis (1974), for instance, examined the relative effectiveness of modeling, direct participation in the activity, and a combination of modeling plus participation in reducing children’s fear and avoidance of water activities. Forty boys, ages 5-12, were pretested on a swimming-related behavioral avoidance scale. The boys were then matched according to their avoidance of swimming activities and assigned to one of four experimental conditions: (a) a model plus participation treatment, (b) a model on-
In the modeling plus participation treatment, each subject viewed a film of coping models who were initially afraid of the water, but progressively overcame their fear and engaged in various swimming activities. Immediately after viewing the film, the subjects also spent 10 minutes in the pool with the instructor who encouraged them to engage in a number of swimming activities. In the model only treatment the subjects viewed the same film, but did not participate in the 10-minute session in the pool. Instead, they sat on the deck of the pool and played checkers with the instructor for the 10-minute period. The participation only treatment subjects saw an irrelevant film, followed by the 10-minute swimming participation session with the instructor. In the control treatment, the subjects saw the same irrelevant film, but participated in the checkers game instead of the swimming session. It was predicted that a combination of participation plus modeling would be most effective in reducing anxiety and avoidance of water activities, followed by the model only and participation only groups (predicted to be equally effective), with the no model control subjects predicted to show the greatest fear and avoidance of the water. The results of the postintervention swimming-behavioral avoidance assessment generally supported the predictions. Specifically, the modeling plus participation treatment was most effective in reducing anxiety, followed by the participation only treatment, with the modeling alone group being third most effective. All three of these treatments significantly differed from the control. In a similar study, Feltz, Landers, and Raeder (1979) examined the effectiveness of participant, live, and videotape modeling on the learning of a high-avoidance back dive. Based on Bandura's (1977) theory of self-efficacy, it was predicted that the participant model group would perform more correct back dives and exhibit stronger efficacy expectations as compared to the live or videotape model groups. It was also predicted that subjects in the live model condition would exhibit better performance and higher efficacy expectations than subjects in the film model condition. The results supported the predictions, in that the participant model subjects demonstrated better performance and had higher efficacy expectations than the live or videotape model groups. Contrary to predictions, however, no differences in performance or efficacy resulted in the latter two groups. It was indicated that the lack of any differences between these groups occurred because the videotape model was very realistic, suggesting that a less realistic videotaped model would not be as effective. Although only a few studies have been conducted in the area of modeling, motor performance, and anxiety reduction, the results are very useful. First, modeling can be an effective tool in helping individuals reduce the anxiety associated with learning new activities, while at the same time increase their self-efficacy. It is clear, however, that if one intends to maximize these effects, modeling must be combined with participation in the activity itself.

**Summary**

Without question, modeling is the most widely used teaching technique employed in physical education and sports, but it has only been in recent years that physical educators have begun to systematically investigate the phenomenon. As few as the investigations conducted to date are, some tentative conclusions may be drawn to guide us in our teaching and coaching.
1. Modeling is an effective technique of conveying relevant information to facilitate an observer's motor skill acquisition. Intuitively, teachers and coaches have always known this to be true. We now have considerable data to support the practice long used in our profession.

2. An established relationship exists between observational learning and the motor task to be learned, in that modeling effects are highly specific to the type of task being performed. In addition, factors influencing the modeling process such as symbolic coding and temporal spacing are to some extent dependent on the task properties. Coaches and teachers must, therefore, consider the nature of the task being learned and attempt to modify the type of demonstration employed to correspond to the characteristics of the skill.

3. The evidence suggests that, for whatever reason, the higher the status of the model, the more the model will be attended to and imitated. Thus, a teacher or coach makes a better model for skill acquisition than a peer. This further suggests that a filmed demonstration of a highly visible or well-known athlete will be more effective than an unknown model.

4. High-status models must accurately and skillfully portray the skill. Evidence exists which suggests that low performance or incorrectly modeled skills by high-status models will be modeled by observers. Thus, we should ensure that the models we use (either filmed or live) should ably demonstrate the motor skill to be learned.

5. It has also been shown that models who are the same sex as the observer will, at times, have a greater effect on motor performance than opposite sex models.

6. Tasks that are readily broken down into natural subunits may be more effectively learned if the model demonstrates each natural subunit in sequence, allowing the observer the opportunity to practice each subunit before progressing to the next subunit. It must be remembered, however, that this is not true for all skills and the complexity of the task must be considered.

7. Following the modeled act, symbolic and verbal rehearsals of the task sequence to be learned facilitates performance; however, the mode to use depends upon the nature of the task used.

8. Modeling can be used effectively to reduce the heightened anxiety and fear that some individuals experience when learning unfamiliar skills. The research shows, however, that to maximize these effects, modeling should be combined with actual participation in the activity itself.

Lastly, it is important to recognize that research into motor skill acquisition via modeling is definitely in its embryonic stage and the conclusions just proffered may be expanded upon considerably as more and more physical educators conduct systematic research into this important process.

REFERENCE NOTE


REFERENCES


