The Generalizability Effect of Learning Strategies for Categories of Psychomotor Skills

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This paper emphasizes the need for the recognition of the importance of cognitive processes and appropriate learner strategies for achievement in psychomotor tasks. A task-analysis procedure in an informational processing perspective is proposed that should help classify tasks in order to determine strategies that instructors might teach and learners might use. The primary objective is not only to aid initial learning in formal instructional programs. We are also concerned with learners developing an ability to generalize to and to accommodate potential future related task demands once they have finished their programs and are on their own.

Most instructional and training programs emphasize the mastery of specific content (knowledge and/or performance skills) with a general disregard for those cognitions and learner strategies involved in the process. Yet, after completing a program, a person may be faced with a variety of other related task demands in various situational contexts. As is well recognized, it is virtually impossible to teach or learn specific content for all of these eventualities. Since a limited amount of content can be directed toward specifics within the time appropriated to a typical instructional program, what can or should the learner learn how to do, in order to generalize and to accommodate potential future demands?

The need for learners to learn how to analyze, problem-solve, adapt to, and generalize in future learning-performance situations has increasingly been called for by educators and psychologists (e.g., Norman, 1973; Simon, 1975, 1980). It might be expected that those who acquire meaningful task-solving strategies should achieve more effectively than those who do not after the formal instructional program is terminated. The ability to retain and transfer knowledge and skills is thus a function of (a) content mastered and (b) strategies learned and used to adapt to, and problem-solve in, subsequent situations. Should not learning processes be influenced more in formal physical education, sport, and other instructional programs in order for learners to be more effective in subsequent situations (Johnson, 1979; Singer, 1978)?

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Although movement skills are specific to the situations in which they are to be applied (and Henry's [1960a] theory of motor specificity has held up very well through the years), this does not mean that strategies that can be used are specific to each situation as well. Strategies that can support learning and performance may be classified as primary and secondary. Primary strategies are directly related to achievement in skills. Also called associative (Gagné & Briggs, 1974), they are represented by those behavior processes that a person uses to select and to govern attentiveness in a learning situation, the management of information and retrieval skills, and the construction of a problem solution. Secondary strategies, also termed support (Dansereau, 1978), allow the primary strategies to operate more effectively. They have to do with establishing right attitudes (a readiness) toward learning and performance, coping with concentration deficits, dealing with potential anxiety, and in general being able to monitor progress and personal states.

Primary and secondary strategies reflect potential cognitive control over performances and feelings (Singer, in press). When learners possess a greater variety of effective strategies that can satisfy situational demands and personal achievement styles, their accomplishments should be much greater.

Verbal materials/skills have been studied considerably more than motor skills as to the identification of relevant learning strategies. The general aim of strategies research in both behavioral domains typically has been to have learners focus on the principles of strategy usage and the various situations in which rules that govern performance for a specific task may be applied. However, it is still uncertain as to which strategies introduced in what manner, and when, will lead not only to enhanced acquisition but also to retention and transfer potential (generalizability).

Furthermore, there is relatively scant research on task analysis procedures designed for as well as used in the psychomotor domain. Thus, the systematic evaluation of the effectiveness and generalizability of strategies in relation to various categories of tasks is virtually unknown. In addition, very rarely are alternative strategies introduced to learners. Considering the nature of individual differences with regard to cognitive styles, people might try alternatives to see which ones work best for them. It seems that such information would be extremely valuable in order to formulate the best instructional and training programs. Thus, the objectives of this paper are to (a) contribute to an understanding of how to influence learning through task analysis procedures for the purpose of strategy identification/application, and (b) have an impact upon the nature and approach taken in instructional and training programs.

Classification Systems in the Psychomotor Domain

A classification system is usually designed to describe and categorize behaviors that share certain elements, whereas a taxonomy usually includes a hierarchical progression of behaviors. Of the taxonomies that have been developed, Fleishman (1967) has attempted to relate abilities to motor performance. Harrow (1972) has expanded this approach to include reflexive and basic movement patterns. They both acknowledge the role cognitive behaviors play in skill performance but, because the taxonomies were designed to help describe the physical aspects of task performance, neither scholar tried to explain the cognitive functions associated with motor behavior. However, Simpson (1966, 1972) characterized behavior in the psychomotor domain as reflexive of the mental, emotional, and physical states of the performer. Indeed, the relationship among these three domains
of behavior cannot be overlooked if motor skill performance is to be described appropriately and effectively (Singer, 1978; Singer & Gerson, 1979).

The omission of detailed descriptions about the relationships among the three domains of behavior and how learner processes may be or are involved has been a major limitation of the taxonomies of the psychomotor domain. Beyond identifying task components, or "doing" skills, there has been virtually no attempt to determine pertinent strategies, or "thinking" skills, prior to or during skill acquisition. In light of the limitations of previous classification systems, Singer and Gerson (1981) presented a task classification system in which an attempt was made to organize the cognitive aspects of psychomotor behavior. That is, it was proposed that psychomotor skills be categorized according to three factors: the information processing demands placed on a learner, environmental pacing conditions, and feedback availability.

Singer and Gerson's model was scientifically appealing. However, in earlier research, difficulties were observed in identifying and administering strategies associated with the processes described in the model. Therefore, the approach taken was reconsidered in order to simplify it and make it more practical. The Singer-Gerson model was modified in subsequent studies (Brown, Singer, Cauraugh, & Lucariello, in press; Singer & Cauraugh, 1984; Singer, Cauraugh, Lucariello, & Brown, in press).

The modifications involved specifying three general processing functions that occur in sequence, and strategies related primarily to each one, considering all types of motor tasks. An understanding of the sequential information processing procedures used by learners undertaking many motor skills suggests that tasks can be analyzed according to these three considerations: (a) informational analysis, (b) response generation and organization, and (c) feedback use. In turn, pertinent alternative or complementary strategies can be identified as associated primarily with each of them. Logically, the selection of the best strategy (or strategies) should lead to the most efficient functioning of processes related to analyzing situational information and contexts, generating and organizing a response, and using feedback when appropriate (if available).

Fitts (1965), in an earlier work, emphasized the continuous interplay of input, output, and feedback processes. He stressed the need for taxonomy for processes and activities involved in learning/performing motor tasks, rather than one for static elements.

To reiterate, special considerations can be identified with regard to the kinds of strategies that are relevant to the intended learning outcomes in psychomotor tasks. For instance, in the study of verbal material or word memorization, many strategies have been employed and compared, such as the use of mnemonics, chunking, coding, association, and the like. For the learning of motor skills, in contrast, learners must frequently develop anticipatory behaviors, selective attention for changing environments, and ongoing feedback strategies. Many strategies are unique for situations associated with psychomotor learning. There is a need to determine alternative strategies for particular classes of tasks, categories possessing unique characteristics.

One question that arises is, how might strategies be determined for categories or classes of tasks? A simple classification of motor skills would be to determine those that are closed or open (Gentile, 1972; Poulton, 1957), otherwise termed self-paced or externally paced by Singer (1980b). Closed tasks can be initiated when the learner is ready. The environment is stable and predictable. Open tasks require appropriate responses in dynamic situations. Decisions may have to be adaptive to unpredictable events, and responses performed very rapidly.
For a closed task, a strategy to develop a narrow and consistent focus of attention is desirable. On the other hand, anticipatory behaviors may be relevant to success in an open task. Additional strategies could be identified as differentially appropriate for each type of task. Later in this article will be presented a practical example of proposed strategy use in a systematic way.

Another classification consideration is the length of the motor act; some are extremely brief and rapid (ballistic) while others are slower and longer. In the first case, the strategy might be to acquire preprogramming skills as appropriate, with little if any attempt to monitor ongoing feedback. In the latter case, one could monitor feedback but must learn strategies as to what to pay attention to, when, how often, and to what extent during the completion of the activity.

Information Processing Task Analysis

Some form of control can be potentially exerted by the learner/performer from the time information enters the system until it is transformed and responded to in the form of movement activity. A great deal of information processing occurs, possibly under severe time constraints, when people attempt to learn/perform complex motor activities. The desirability of exerting deliberate conscious control will depend on many factors. One of the primary differences between the highly skilled and the lesser skilled is the degree and type of conscious involvement prior to, during, and following motor performance (cf. Singer, Gerson, & Kim, 1979). Therefore, conscious planning, focus, and/or intervention at a particular stage must be determined according to task demands and the capabilities of the person.

The term cognitive processes, or cognitions, has been defined in many ways. Interpretations have varied (e.g., Battig, 1975; Hunt & Lansman, 1975; Norman & Rumelhart, 1975), as have the contexts in which the term has been applied. For purposes here, a cognitive process is defined as a control process that is a self-generated, transient, situationally determined conscious activity a learner uses to organize and to regulate received and transmitted information, and ultimately, behavior (Singer, 1980a).

However, the person does not actually totally influence any situation, nor is the reverse likely to happen. Whereas behaviorists might lead us to view human behavior as passively controlled by situational dictates, cognitive psychologists would suggest that people actively control their environments. The truth probably lies somewhere in a middle position. Behaviors are not produced without cues or stimuli, and these behaviors are directed accordingly. But all people do not respond similarly to the same events, thereby demonstrating some degree of self-determination. In a sense, then, associationistic behaviors are indeed developed, but in a person's own way.

The learner/performer may invoke cognitive processes to perceive the nature of the task in the context of the environment, to recognize similarities between the present task and previous experiences, and to selectively attend to and identify the most relevant, yet minimal number of cues necessary for a response to occur. In addition, a person may utilize cognitive processes to enhance goal-expectancy formations, to enhance goal-image formation, or to finalize movement decisions made in the short-term store. Cognitions may be used to permanently store evaluative feedback and causal reasons for a performance outcome for future use, information that will influence future behavior in the same situation. Cognitive processes should be facilitated by the learner's activation and implementation of appropriate strategies.
An effective strategy has been described as the simplest and most efficient means of processing the information inherent in a situation (Newell & Simon, 1972). Rigney (1978) has stated that a strategy may be interpreted as signifying operations and procedures that a learner may use to acquire, to retain, and to retrieve different kinds of knowledge. To Gagné (1974), a strategy is a skill of self-management that the learner acquires to govern the processes of attending, learning, and thinking, while Gagné and Briggs (1974) have suggested that a cognitive strategy is an internally organized skill which governs the learner's own behavior.

A strategy is interpreted here as a self-initiated or externally imposed way of directing information leading to decisions for purposeful behavior (Singer, 1980a). A learner imposes some type of structure on movement information so that it is learned and retrieved more efficiently. Performance is either dependent upon the experimental structuring of the task in which the totality of the relations among the movement cues is emphasized (Gentile & Nacson, 1976), or the subjective organization of the information, in which a structural context corresponding to the learner's cognitive capabilities is imposed on the movement cues. Thus, the development of organizational strategies occurs in one of two ways.

An instructional strategy imposed by the instructor on the learner may be designed to help the learner acquire a skill as quickly as possible, or to facilitate transfer effectiveness or problem solving in the future. While some imposed strategies may increase the rate of initial skill acquisition (Singer & Pease, 1976, 1978), they may not facilitate learning in transfer situations in which no instructor is present (Singer & Gaines, 1975). In the latter case this can only be achieved when a learner becomes capable of self-generating strategies, whether they have been initially externally directed or self-generated.

A self-initiated strategy is one in which the learner is capable of determining a procedure that is compatible with personal cognitive capabilities and cognitive style for the learning of a task or a category or related tasks. Strategy choice is partially determined by the particular situation (Bruner, Goodnow, & Austin, 1956), so a sound procedure would appear to be to initially instruct learners in the use of learning strategies if they are ignorant about them. Once a learner comprehends the nature of and the reasons for the use of particular strategies in acquiring skill, he or she should be capable of self-generating strategies in related future learning environments. We will consider here the possibility of analyzing tasks according to information processing demands at stages of information receipt, response generation, and feedback use, with implications for the implementation of appropriate strategies.

Informational Analysis

Numerous strategies are associated with sensory-perceptual processes that are of potential value in the processing of information, and ultimately in motor performance. For example, those who have researched vigilance and tracking behaviors (e.g., Mackworth, 1950) have shown that the ability to focus attention on one cue or to change focus to alternative cues, depending on the situation, is very advantageous in performance. Shiffrin and Schneider (1977) also point out the importance of attention during controlled processing in terms of successfully searching visual displays for target items. Additionally, Harnmeron and Tichner (1970) found significant performance differences (in time on target) between groups tracking visible targets and groups tracking targets that randomly disappeared from view. These variations in performance, according to Flowers (1978), were indicative of the particular strategies employed to track the moving target.
Other research has been concerned with anticipatory timing, that is, learning when a stimulus event will occur so that the overall response can be made at the appropriate moment in relation to the event (Adams, 1964). Poulton (1957) and Adams (1964) have indicated that superior performance occurs when individuals are able to effectively employ some type of anticipatory strategy.

In studies in which an attentional set has been of concern, Henry (1960b) and Christina (1973) have concluded that attention to a sensory set (the signal, as in a track event) enhances reaction time more than attention to a motor set (the response, as in the start). These researchers used complex tasks involving both temporal and spatial alterations. When a simple task was tested, enforced motor set produced significantly shorter reaction times than enforced sensory set (Wrisberg & Pushkin, 1976); no reaction differences were found for a more complex version of the task. However, McGowan (1976) warned that stimulus intensity makes the difference in performance outcome; either set may be effective, depending on the quality of the stimulus cue.

Additional research concerning the preparatory state for movement acts has revealed that subjects complete responses more efficiently when they prepare (prime) the system for the upcoming movement(s) (Kelso, in press). Strategies related to an improved preparatory state would certainly enhance performance.

**Response Generation and Organization**

Various processes and strategies are associated with the generation and organization of a movement (or series of movements), depending upon the characteristics of the task (Glencross, 1978), skill level of the performer (Larkin, McDermott, Simon, & Simon, 1980), and performance of the individual (Damos, Smist, & Bittner, 1981). Unfortunately, although Glencross (1973) has suggested that strategies are necessary components of response organization and skilled performance, there is little research as to how instruction in one or several strategies would help to produce skilled movement behaviors.

Strategies for response organization must be compatible with the nature of the task. Glencross (1978) has proposed seven phases or subprocesses involved in the organization of a response, all or some of which might be involved in one action: (a) the discrimination and selection of appropriate response units, (b) the sequencing of selected units into an effective order, (c) the phasing, or temporary structuring, of the units in the sequence, (d) the grading of the units and the response as a whole in terms of physical effort, (e) the timing of the whole response to an external event or objects, (f) the selecting from alternative possible responses, and (g) motor control, the stage of development of the cognitive structure controlling the movement act. This type of microanalysis of a response is helpful, as is a more general analysis, in suggesting strategies pertinent in a learning situation.

Furthermore, Rosenbaum (1980) and Miller (1982) have discussed the importance of utilizing preliminary, precued information in the organization and specification of movement response parameters. It has been suggested that different learner strategies may influence the specification of response parameters and subsequently the movement act.

**Feedback Use**

Skilled performance is often evidenced by a learner’s approach to the use of response-produced feedback. A highly skilled performer knows which feedback cues are
relevant and when and how much they should be attended to, while the less skilled person is less effective in this regard.

Performance differences may be related to learner use of feedback cues that activate different sense modalities. For example, unless specifically instructed to attend to kinesthetic cues, a person will probably concentrate on visual input (if available) to improve motor performance (Kelso, Cook, Olson, & Epstein, 1975; Posner, Nissen, & Klein, 1976). This is because vision is the dominant modality, especially in the early stages of learning (Fleishman & Rich, 1963). In certain situations, however, attention to visual cues derived from feedback does not enhance performance. In fact, performance may even become impaired (Kelso & Frekany, 1978). Thus, it is imperative that explicit procedures be designed to control the allocation of attention to appropriate feedback cues in specific situations.

Attention to pertinent feedback cues is important when a learner attempts to determine, for example, the location or distance of a performance error. It has been well established that location cues are sensorily encoded and rehearsed in memory (Diewert, 1975; Laabs & Simmons, 1981; Stelmach, Kelso, & Wallace, 1975). Diewert and Roy (1978) have found that memory for movement extent information can benefit from either a location strategy or a counting strategy. They suggest that there is flexibility in the way extent information is coded. Memory depends on the availability of processing capacity for a location strategy, but capacity is not so important for a counting strategy. Diewert and Roy conclude that kinesthetic information is not useful for extent memory; instead, coding strategies should be used. The prominent role that verbal labeling and counting strategies play in the encoding of movement information was further substantiated by Laabs and Simmons (1981).

Feedback (auditory, proprioceptive, and visual) is currently viewed as an integral part of motor control. The detection and correction of movement errors is highly dependent on feedback signals concerning goal attainment (Keele, 1982). In order to assist performers in processing this information, various strategies should be examined. The use of feedback is a potent variable in motor skill acquisition. Strategies for feedback utilization can only be activated after the response has been initiated. Strategies related to personal and situational appraisal, for example, attributions, are also formulated as a result of feedback.

**Strategies and Achievement**

Appropriate strategies facilitate the acquisition of verbal skills (Belmont & Butterfield, 1971; Brown, 1975, 1978; Dansereau, 1983) and motor skills (Ho & Shea, 1978; Shea, 1977; Singer, Hagenback, & Gerson, 1981). In terms of the acquisition of motor skills, instructor or experimenter-imposed strategies have required subjects to (a) think about or imagine motor responses or movement patterns in particular situations; (b) attach verbal labels to each of a series of movements; (c) selectively attend to relevant components of a task; and (d) verbally rehearse a sequence within a movement pattern (Hall, 1978).

The strategies used in such psychomotor studies as cited above were task-specific, designed to improve the acquisition of a particular motor skill, for example, serial positioning. There was no attempt to examine the effect of strategy learning under conditions involving other related tasks. The need for future research on strategy usage was further emphasized by Morris, Bransford, & Franks (1977), who showed that the retention and transfer of verbal skills was a function of the similarity between the test situation and the
acquisition strategy. When a difference existed, decrements in performance occurred. It is a challenge for motor skills researchers to be able to show that, while transfer from skill to skill may be task or situation specific, strategy transfer in motor behavior situations may be somewhat generalizable.

In conclusion, there is virtually no research on the generalizability of strategies in the cognitive area other than that conducted by Dansereau (1983). In the psychomotor area, the only research concerned with the generalizability of strategies appears to be the preliminary work completed in our laboratory (Singer & Cauraugh, 1984; Singer et al., in press).

Variations of the pursuit rotor were used in one study and variations of a maze task were used in another study. Determined was achievement in similar tasks—primary and modified primary tasks. Essentially, the results supported to some degree the notion that strategies are generalizable across related tasks. However, additional research is necessary to further delineate the categories of tasks and conditions under which strategies are generalizable.

Cognitive Styles and Learning Strategies

The discussion thus far has centered around learner processes and strategies in general. And what about individual differences? An optimal level of achievement in specific tasks is thought to be dependent upon the interaction and ideal matching of a person's unique cognitive style and instructional conditions (Cronbach & Snow, 1977; Singer & Gerson, 1979). Cognitive style refers to an individual's preferential mode of responding in learning situations. Although it is of increasing interest to educational researchers concerned with cognitive behaviors, cognitive style research has lagged behind in the psychomotor domain.

Two contrasting cognitive styles, of potential interest to those who teach motor skills, can be classified on the basis of conceptual tempo: reflective and impulsive (Kagan, 1965; Kagan, Rosman, Day, Albert, & Phillips, 1964). Reflectivity refers to the tendency to ponder over solutions when several alternatives are possible. Impulsivity, on the other hand, is associated with responding quickly and not taking the time to carefully select the correct problem solution.

Research in the verbal/cognitive domain has generally shown that reflective individuals use more efficient learning strategies and demonstrate a more efficient deployment of attention than impulsive individuals (Denny, 1973; McKinney, 1973; Siegelman, 1969). Furthermore, memory scanning studies reveal that reflective subjects tend to employ part scanning strategies, while impulsive subjects use whole scanning strategies and spend less time on alternative approaches (Drake, 1970; Siegelman, 1969; Zelniker, Renan, Sorer, & Shavitt, 1977).

Whereas reflectives usually perform slower but with greater accuracy in cognitive tasks when compared to impulsives, little information is available as to what to expect with motor tasks. There is an apparently lack of research on the influence of cognitive style on achievement in motor tasks, especially motor tasks in which performance speed is of great importance. Perhaps the ability to learn and perform well in certain motor skills may be associated with a reflective responding style or an impulsive responding style. For instance, such motor skills as the golf stroke allow information processes related to cue recognition, decision-making, and the organization of movements to operate with the luxury of ample analysis and preparatory limb movement time. Consequently, deliberate,
calculated strokes can be made. Other tasks (as in racquetball) require that processes be operational rather quickly. Therefore, the question for motor behaviorists is, do certain cognitive styles and strategies favor achievement in particular tasks and not in others? In addition, can those individuals who possess an orientation to one "style" that may not be appropriate for a certain type of task learn to modify it with an appropriate strategy and therefore be successful in that task?

A preliminary study (Brown, Singer, Cauraugh, & Lucariello, in press) conducted in our laboratory has indicated that appropriate learning strategies in fact interacted with and influenced the performance of subjects identified as reflective and impulsive. Performance on a maze learning task with a speed emphasis demonstrated that learning strategies (imagery, rhythm, and feedback) facilitated maze traversal speed times for reflectives and minimized the incorrect pathways times for impulsives. The Brown et al. study was an exploratory investigation concerning the interaction of task-related strategies and particular cognitive styles with one type of motor task. Further investigations are warranted to determine advantageous cognitive styles and appropriate learning strategies for classes of motor tasks with unique characteristics.

A Practical Example for All Learners

If we consider athletic activities as well as informational load and its nature in situations, as was mentioned earlier, two types of general conditions are apparent. Each one requires dissimilar strategies, although there are some considerations in common.

Self-paced skills are initiated by the athlete when he or she is ready. There is time to prepare, preview the situation, and completely control the movement. The serve in tennis is a good example of a self-paced act.

Externally paced skills are reactive to the conditions. The situation paces the person. A response may have to be emitted suddenly and adaptively. For instance, when the ball is in play, a tennis player at the net must be ready to react to one of a number of possible alternative shots, anticipate on a probability basis, not commit until necessary, and respond adaptively to the requirements of the situation.

If the player is in a good position and/or the ball is returned predictably and slowly enough, there is enough readiness and preview time. The response to the shot then takes on the characteristics of self-paced strokes. There are special considerations with regard to mental preparation to execute self-paced skills or those with similar situational parameters. For externally paced skills under contest conditions, there is little time to ready, preview, make decisions, and execute. However, in practice many of the circumstances can be modified to allow for some degree of self-paced practice. Balls can be delivered slower or more predictably (cf. Billings, 1980).

Under these conditions the tennis player can develop a routine, a strategy, that works well prior to and during the act. A true self-paced stroke, like the serve, should be practiced as it will be generated in the contest. Adjustments need to be made for externally paced conditions, however, as the player must learn to anticipate and make flexible decisions rather quickly. Furthermore, in practice, self-evaluation as well as modifications in strategies and techniques occur, and learning is advanced. This is virtually impossible under the stress and pace of contest competition.

The self-paced act is practiced repetitively until it becomes habit. The objective is consistency in appropriate behavior. Many externally paced acts are practiced as if self-paced at first. But they should not be learned to the extent that they are too automated.
More varied practice circumstances and diverse opponents will provide different kinds of demands and opportunities. For purposes in this paper, a strategy for the execution of self-paced skills will be described.

The following procedures are suggested to represent one global strategy which can be applied to any self-paced sport act. They should be practiced until they occur somewhat automatically. They should also be effective in all sports in which self-paced skills are used, such as stroking a golf ball, bowling, archery, diving, and shooting a foul shot in basketball. The global strategy is recommended for all skill level players. It has been formulated on the basis of interviews with many athletes, personal experience, and research on selected aspects of the overall strategy. Our preliminary data (e.g., Singer & Suwanthada, 1984) on the entire strategy appear to be quite favorable to our hypotheses, and we are now in the process of investigating it in detail.

**The Strategy**

The five sequential procedures are: readying, imaging, focusing, executing, and evaluating. For readying, the learner should

- Get comfortable physically;
- Try to attain an optimal mental-emotional state for the task and situation;
- Attempt to do things in preparation that are associated with previous personal best performances;
- Try to be consistent in attaining the preparatory state for the act.

For imaging, the learner should

- Mentally picture him/herself performing the act briefly as to how it should be done, from the result of the act to the initiation of the movement;
- Think positively and feel confident;
- Feel the movement.

For focusing, the learner should

- Concentrate intensely on one relevant feature of the situation, such as the seams of the tennis ball to be hit;
- Think only of this cue, which will block out all other thoughts.

For executing, the learner should

- Do it!
- Do not think of anything about the act itself or the possible outcomes.

For evaluating, the learner should

- If time permits, use available feedback information to learn from;
- Assess the performance outcome and the effectiveness of each step in the routine;
- Adjust any procedure next time, if necessary.
Some Explanations

This five-step procedure should be rehearsed repeatedly for any event or act that allows for sufficient preview time of the situation, and especially in a stable and predictable environment. With practice it will become routinized in competition. If difficulty is encountered with a particular step, it should be isolated and practiced separately.

For instance, imaging can be practiced away from the sport setting. When the ability to create a clear and vivid picture of the act and its outcome in the mind is learned, imagery should be incorporated within the routine in the sport setting. The training of the mind promotes a greater probability of performance success, and with more regularity.

Speaking of the second phase, imaging, many athletes use some form of self-talk in connection with it. One or two of the most relevant performance cues are identified and expressed internally while imaging, and these differ from athlete to athlete. For instance, one cue for the tennis player may be a reminder to stroke through the ball. Imagery and self-talk represent a technique to mentally cue and prepare the athlete to execute correctly.

With regard to the third and fourth phases, focusing selectively and executing with a quiet mind, one of the obstacles to good performance is thinking too much. Distractions, over-awareness of the opponent, or an attempt to evaluate during contest performance may result in disastrous effects. We all have a capacity to attend to a certain number of ideas or cues in a brief time frame. By focusing intensively on one cue, such as the seams of the ball, attentional capacity will be filled. No mental space will remain for thoughts that might be counterproductive during performance.

As we can see, strategies can be linked together and incorporated into a broad plan of behaviors preparatory to action. The five-step approach proposed here is merely an example of possibilities. It also represents an attempt to bring laboratory findings to real-world settings, and to have a real influence on instructional-learning situations in which psychomotor skills are involved.

Future Directions

A strategy has been generally defined as an optimal organization of cognitive processes designed to achieve a goal for a task (Logan & Zbrodoff, 1982). A classification system for psychomotor tasks would be helpful for the purpose of indicating appropriate learning strategies that can be applied to motor skills. The system proposed in this paper includes three considerations: informational analysis, response demands, and feedback availability. (This model is similar to the perceptual, cognitive, and motor model of Card, Moran, & Newell, 1983.) Several strategies can be identified for each category, such as imagery, controlled processing, selective attention, anticipatory timing, rhythm, and visual and proprioceptive feedback use.

Unequivocal evidence is lacking in support of strategies identification and implementation, especially for the transfer or generalizability of strategies. Other than the preliminary work completed in our lab, a primary task has only been used with the attempt to determine the ability of subjects to acquire and attain skill in it. In the future, scholars should be concerned with the generalization ability of subjects to acquire strategies while learning a task in one context, and how they are able to use these strategies in task-related activities.

Learning strategies developed by a learner in accordance with cognitive abilities and situational demands, states Bruner (1961), should be most effective in relating new
information to previously obtained experiences. Furthermore, Keele (1982) has suggested that superior skilled performers may be the ones who are strong in specific cognitive capacities other than perceptual-motor capacities.

O'Neil (1978) with regard to the cognitive domain, O'Neil and Spielberger (1979) with concern for the affective domain, and Singer (1980b) relative to the psychomotor domain have repeatedly proposed that learning strategies be included more conscientiously in instructional programs. Psychomotor activities can be studied as to (a) task analysis from an information-processing (cue availability and response demands) perspective; and (b) those learner strategies most pertinent to directing cognitive processes associated with achievement. First of all, particular strategies must be identified and recognized as being generalizable in application to tasks possessing similar characteristics and making similar demands (as in a class or category of tasks or activities). Once a conceptual-research foundation has been established, a classification scheme of psychomotor tasks could be formulated. It would suggest those strategies of apparent benefit to most students learning tasks with particular specifications, to be performed in certain situations.

The classification scheme should be assessed experimentally to determine (a) the instructor's ability to identify strategies important for achievement in a class of related activities, and (b) the learner's ability to learn and apply these strategies, appropriately resulting in better achievement in tasks than would be the case in the absence of such strategies. Such research efforts have the potential for freeing learners from continual instruction and observation. Once they understand how to use specific knowledge (and skills) and also apply performance strategies effectively to related tasks, they will be able to work independently in adapting to future problem situations.

References


EFFECT OF LEARNING STRATEGIES


