Ecological Validity in Understanding Sport Performance: Some Problems of Definition

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One of the most significant aspects of current sport psychology research is the trend toward developing the relationship between theoretical concepts and practical applications. There have been many recent calls for the development of specific experimental paradigms closely linked to critical features of movement control and social interaction within specific frames of reference such as competitive sport (e.g., Lee & Young, 1985; Martens, 1979). The concept of ecological validity has been proposed as a crucial element of this current research thrust, and this paper attempts to identify and define some of the more important criteria underpinning ecologically valid research in sport psychology. Vision and sport performance is used as an exemplary area of investigation in which problematic and specific issues are examined. The basis of this critique has important implications for other areas of interest in the application of the behavioral sciences to sport. It is concluded that much greater debate must be stimulated concerning this important methodological principle, and a preliminary definition is provided for this purpose as well as to aid in the process of research evaluation in sport psychology.

For many scientists, sport is a viable area of study primarily because of insights into human behavior in unique settings. The psychological analysis of sport has traditionally focused on theoretical problems concerning the acquisition and performance of perceptual-motor skills and social interaction variables within a competitive framework. It is well documented how recently sport psychology, as an academic subdiscipline, has undergone a shift in emphasis toward more applied perspectives (e.g., Cratty, 1984; Martens, 1987). The term ecological validity has surfaced regularly in discussions on this change of outlook, and the present paper is intended to critically examine this concept which is purported to guide much of the recent work in sport psychology.

An attempt to examine the nature of such a methodological concept, utilizing examples from the whole range of sport psychology research, would be both fu-

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tile and beyond the scope of the present review. Therefore it is intended to concentrate extensively on the experimental paradigms prevalent in the study of visual perception and sport performance. This exemplification helps to indicate how the process of research evaluation in physical education and sport psychology may be enhanced. The ultimate aim is to help clarify procedures of discrimination between worthwhile scientific endeavor and that of limited value. Consequently, many of the issues raised in this paper may appear specific to a particular body of research, although the underlying considerations have relevance for sport psychology in general.

The appropriateness of ecologically valid techniques of analysis has been outlined in diverse areas of sport analysis. These have included the study of psychological factors such as anxiety and arousal (Martens, 1979), social psychological problems (Bird & Ross, 1984), and attempts to verify the exact relationship between perception and action (Lee & Young, 1985). Despite growing realization of the importance of close links between investigatory methodology and real-life events in the sporting sphere, a fundamental definition is still lacking. It is argued that without even a general appreciation of what the concept of ecological validity may represent, the development of sport psychology research, with its overall aim of understanding human behavior in sport, may be greatly retarded. Thus the divergent courses of the "two sport psychologies" convincingly highlighted by Martens (1987) may be remediated by attention to such important conceptual arguments. In a more practical vein, it is worth reflecting on the role of such a conceptual clarification in regulating the boom in practicing sport psychology consultancies that has caused expressions of alarm in some quarters (e.g., Nideffer, 1981).

**A Suggested Definition of Ecological Validity**

It is therefore proposed that ecological validity is a transient phenomenon characterized by informed and systematic attempts to analyze actual behavior within specific environmental contexts, utilizing unobtrusive, realistic, and reliable methods of investigation. Quite clearly, the more exact the replication of actual behavior patterns in controlled and specific settings, the greater the credibility in the application of accrued data. This approach obviously represents a feasible modus operandi for sport psychologists interested in generating knowledge rather than solely working with "recipient" material (Wilberg, 1973).

**Some Problems in Perceptual-Motor Skills Research**

In the study of the role of perception in motor control during sport performance, greater effort is being directed toward examining realistic action sequences. However, it is difficult to shed the legacy of previously fashionable paradigms of investigation that emphasize the use of highly specific laboratory-based tasks. The result has often been the provision of sterile sources of data (Leibowitz, 1976; Neisser, 1976). The importance of the sport setting has often been marginalized and its perceived relevance ignored. In perceptual-motor skills research has existed a pervasive belief that the study of isolated, basic motor components may provide insights into the mechanisms that function in the complexity of real life. Martens has termed this a reductionist perspective and points out
that, "The [laboratory] experiments strive for external validity, but only to the extent that they do not sacrifice internal validity" (1987, p. 42).

Indeed, the role of cognitive control processes in skilled performance, in which action may be constructed of response components specifically designed to deal with diverse sport problems, is virtually negated in the mechanistic interpretations of motor control provided in such literature. There has been a concomitant tendency to build, rather unjustifiably, grandiose explanations of sport-skill performance on the basis of data from this type of laboratory task. Often minimal movement is involved, despite the view that "the contextual setting is what distinguishes action from movement" (Whiting, 1980, p. 539). The implication is that the cognitive element may be missing from such perceptual-motor investigations.

To be sure, the problem of knowing how best to control the myriad of impinging variables is a difficult one for the sport psychologist since it is a fine line that separates realism from confusion. The essential relationship of interest has been pinpointed as a notional balance between scientific merit and applied relevance (Silva & Parkhouse, 1982). Obviously these are not mutually exclusive descriptions of scientific research, but undoubtedly, the sport scientist must give due consideration to both aspects. Perhaps this relationship has been best summarized by Martens (1987) as supporting "experimental" and "experiential" methods, although the latter has been substantially subjugated for perceived lack of scientific credibility. Perceptual-motor research that has balanced the two aims well (e.g., Lee, Lishman, & Thompson, 1977; Lee, Young, Reddish, Lough, & Clayton, 1983) remain the exception rather than the rule. Consequently, much of the research into perception and sport has occurred in sterile laboratory conditions in order to satisfy the criteria of established scientific methodology.

In summary, there exist clear indications of a recent paradigm shift (Kuhn, 1977) in sport psychology research, and subsequently a greater willingness by sport scientists to apply the concept of ecological validity in their work. This has signaled increasing effort toward making experimentation more realistic and sport oriented. However, this important research thrust may be more effectively directed if workers concerned themselves with clarifying the tenets of this concept in order to guide the process of evaluation. Such a view is highlighted in the following sections of this critique in the presentation of a preliminary conceptual analysis.

**Ecological Validity: A Conceptual Analysis**

Implicit in the previous section is the view that visual perception in sport cannot be solely examined in the laboratory. Indeed, for some the need to relinquish many of the negative characteristics of restrictive laboratory practices, in the quest to produce practically significant data, is paramount (Gill, 1981). This problem has been recognized more generally by psychologists and many have heeded the criticisms of Neisser (1976, p. xi) that, the actual development of cognitive psychology in the last few years has been disappointingly narrow, focussing inward on the analysis of specific experimental situations rather than outward toward the world beyond the laboratory.
The growth of this exciting trend in sport psychology has been documented elsewhere (Davids & Breen, 1986). However, crucial issues of theoretical import require resolution if this research principle is to be utilized to the fullest. The problem in a nutshell is this: Currently it is fashionable to use the term ecologically valid when describing many sport investigations, although there are no established criteria that permit the differentiation of studies which display this characteristic in part extent. Are there tangible criteria that help the sport psychologist to bridge the gap between research and practice?

For example, in a review of a worthwhile collection of papers, representative of a variety of ecologically valid approaches to the study of sport performance, a much-needed rationale of the characteristics of ecologically valid research was omitted (Salmela, Partington, & Orlick, 1982). As yet there exist few clear-cut guidelines for sport scientists on this issue. As an example of the type of problem faced in our field, consider the question of whether studies conducted solely in the field necessarily yield data of greater validity than those that incorporate features from the laboratory in a field setting. It is to questions of this nature that we now turn.

Suggested Criteria of the Concept of Ecological Validity

The sport environment encourages the use of a number of modes of investigation. Ecological validity may be greater in some than in others, and therefore the question hinges on which methodological paradigms are refined enough for use in sport settings. Curiously, recent attempts to identify the major roles of the sport psychologist have neglected to acknowledge explicitly the need to significantly develop methodological approaches and thereby increase the relevance of research findings (Salmela & Palacio, 1985). The interesting challenge for the behavioral scientist in sport is to develop methods of study that reflect the effects of new technologies, novel experimental designs, and fresh theoretical perspectives. This can occur in any of three possible settings: the laboratory, the field, or a combination of these two locations (Davids & Breen, 1986). Selection and justification of appropriate settings for specific problems, such as perception in sport, may be enhanced by the development of appropriate criteria as an aid to planning. Following is a preliminary attempt to distinguish these important criteria for fellow research investigators.

The Criterion of Realism

Obviously, the experimental setting must be as realistic as possible so that important features of behavior such as perception, decision-making, and effector organization remain unaffected by the imposition of experimental constraints. This should be the most explicit aim of the investigator and is, undoubtedly, a complex problem that must be considered when selecting topics for analysis. Investigators must clearly avoid choosing those that are most manageable rather than the most pressing or demanding (Neisser, 1976). There is a constant requirement for the development of alternative procedures of investigation that focus on new ways to approach old problems. Logically therefore, ecological validity, along with other aspects of scientific methodology, must be viewed as a transient
phenomenon. As technology is updated and theories that underpin research design are revised, methods considered ecologically valid at a particular point in the history of a research program may be superseded. The criterion of realism may be subdivided into two basic principles—that of behavior constancy and that of variable specificity.

The Principle of Behavior Constancy. The process of isolating a component of motor behavior for analysis should not significantly cause it to deviate from normal patterns. Clearly, while behavior remains constant, applications of research data become more meaningful. The use of the occlusion technique in investigating catching performance is a case in question. Attempts to specify exact temporal values for minimum viewing periods in successful catching performance have typically denied subjects access to visual cues during specific segments of flight (e.g., Nessler, 1973; Sharp & Whiting, 1974; Whiting, 1968; Whiting & Sharp, 1974). Significantly, the ball was always launched from a projection machine in the dark and was also caught in the dark. There was ample evidence that competent catchers can perform successfully with severely limited access to visual flight cues. However, in relation to specific questions on the precise temporal extent of viewing periods, the occlusion technique was not particularly effective. The generality of much of the findings indicates that an artifact of this paradigm is its inherent specificity. For example, there has been an overemphasis on the significance of perceptual anticipation procedures to which games players resort only when their view of the ball is blocked. Similarly, the subjects themselves reported they were having to adapt their normal movement patterns in order to cope with the problem presented. Hence, according to Sharp and Whiting,

under restricted light conditions subjects moved the hand forward to the catching point and caught with a snatching movement whereas under full light conditions there was a tendency to move with the ball as is done in the normal game situation. (1974, p. 145)

Paradigms that promote the use of such laboratory-specific behavior are difficult to relate to actual circumstances in any true sense and thus lack ecological validity.

Davids (1987) attempted to remedy some of the more critical difficulties outlined above. Normal light settings were used, and a peripheral-visual probe technique, described in detail elsewhere (Davids, 1982), was used to ascertain the information content of selected periods of flight. This changed the task to a more prolific receptor anticipation procedure and provided evidence that inexperienced catchers may need to watch the ball, and their hands, during late segments of flight, since most peripheral-visual errors occurred during this time. This is wholly consistent with current theories of perception that emphasize continuous and direct visual contact with important environmental cues (Gibson, 1979; Lee & Young, 1985; Michaels & Carello, 1981).

The Principle of Variable Specificity. Perhaps the essential point for the criterion of realism is that many of the variables used in specific research investigations should remain as true to actual circumstances as possible. This is a critical feature of external validity, since without the faithful maintenance of variables that govern action, the experimental context may be a prime source of abnormal behavior patterns. In essence, the size, shape, color, and essential characteristics
of the stimuli used in vision and sport research should be tied closely to a field of action for maximum relevance.

To illustrate this principle, it is worthwhile examining the use of laboratory and clinical methodology to assess the development of peripheral vision. Research viewed by Williams (1974) supports the notion that peripheral-visual processing capacity is equivalent in children and adults when measured by tachistoscopic presentation of stimuli (Lakowski & Aspinall, 1969; Liss & Haith, 1970; Miller, 1973). In a discussion on the relevance of this data for ball skill performance, Williams (1974) concluded, "The striking thing is that this basic receptor mechanism function—that of picking up information from the environment—operates as effectively in the five-year-old as in the adult" (p. 348).

However, the tachistoscopic field of view used in that study measured only up to 3 degrees of arc and certainly does not relate too well to the typical visual field found in almost all perceptual-motor tasks. Elsewhere, Day (1975) has argued vehemently that tachistoscopes "do not embody the types of regularities normally encountered in the visual world. It may be primarily in situations where expectancies about the visual world can influence performance that the greatest differences exist between the child's and the adult's field of view" (p. 55). Similar criticisms of the use of tachistoscopic data in the analysis of perceptual-motor problems have been made elsewhere (Davids, 1984; Hoving, Robb, Spence, & Schulte, 1978; Neisser, 1976).

Another essential problem in assessing the development of peripheral vision with laboratory techniques from clinical methodology concerns the use of a central fixation point rather than a central task of some type to stabilize the foveal load. In tachistoscopic and perimetric analyses of peripheral vision, subjects sit facing the measuring instrument, using a bite-bar or headrest to standardize the field of view, while the experimenter manipulates the presentation of peripheral stimuli. In normal circumstances, in everyday life there is usually a central task that absorbs some of the available attentional resources of the actor, for example, in negotiating a crowded pavement or in catching a ball. In summary, studies lacking a central task may produce grossly inflated data, since simply fixating a point at 0 degrees of arc requires only a fraction of the processing capacity of the observer (Ikeda & Takeuchi, 1975). This notion was verified in a comparison of a typical single-task perimetric-based paradigm with a dual-task situation (catch and scan) common to many ball games (Davids, 1987). Results indicated that estimates of the peripheral-visual field were inflated by up to 500% when no central task was present during assessment. The methodological issue here is whether clinical or "pure" measures of visual sensitivity are as meaningful to the sport scientist or coach of ball games as are those measures acquired in the heat of action. Essentially, the analysis of specific sport problems could benefit from a careful interpretation of the most important variables that impinge upon action.

The Criterion of Union

Perhaps the most fruitful avenue for future research involves the refined marriage between the field investigation process and the need for internal validity. Of course, these characteristics may sometimes be found to a large extent in the same study. The aim of the union of laboratory control and a naturalistic
setting would be to produce minimal interference with real-life activity. For example, this may imply a neat and logical progression in research programs from the simple, closed laboratory experiment to the business of investigating complex behavior in sport. The position supported here is that laboratory experiments have an important role to play in certain sections of a program and it must not be falsely assumed that all studies in real-life settings are, by nature, the most ecologically valid. For example, utilizing an ethnographic type of approach in analyzing qualitative features of sport behavior may be inappropriate due to inordinate interference by the presence of the observer.

It is argued that a union of the best characteristics from both types of experimentation may be an optimal way of developing knowledge of the major concepts in sport psychology. Consider some of the recent studies examining the control of sport movements by expert performers (e.g., Bootsma, 1986; Lee, 1980; Lee et al., 1977; Lee et al., 1983). The skills under analysis have included long jumping and ski-jumping, intercepting a ball in space, and smashing in table tennis. Kinematic analysis in all cases have revealed a noticeable amount of consistency in performance which is generally considered to be predominantly under visual control (Turvey, 1987). It is notable that this body of research emphasizes the examination of skilled movement not in a confined laboratory setting, nor in an open game context, but in an area in which action may be isolated from structured competition and studied discretely to gain an uncorrupted picture.

To further exemplify this point, consider the investigation of visual functioning in complex environments such as fast ball games. Many coaches have been convinced of the significance of measures of the capacity to detect and identify stimuli in common clinical tests, such as the Snellen chart, to athletic performance (Tussing, 1940; Winograd, 1942). Sanderson (1981) has outlined the tentative nature of the assumption that static visual acuity (SVA) is a controlling process in fast ball games, due to the lack of relative movement between observer and stimulus in the laboratory. He devised and validated a method for introducing an element of motion to stimuli in an SVA test and then correlated catching success with both the predominant SVA measures and the newer dynamic measures of visual acuity (DVA). The results indicated that DVA, rather than SVA, correlated highly with catching success, inducing Sanderson to argue that the former was an indication of oculomotor coordination. Hence, it may be necessary to carefully adapt clinical tests of vision for use in the context of sport research if findings are to aid pedagogy.

Experimental paradigms that utilize externally biased methods of analysis that are high in internal validity clearly exist, but most of the research in sport psychology suffers from adopting extreme positions. These may be termed reductionism and globalism and may fail due to an overexclusive or overinclusive experimental rationale (Martens, 1987). Application of the criterion of union may represent a significant solution to this difficulty.

The Criterion of Eclectic Analysis

One way to ensure that at least some aspect of a particular feature of sport behavior is analyzed in its real-world form is through the use of a range of analy-
sis techniques. Sport is an area in which the individual is faced with a variety of physical, social, emotional, biological, and cognitive stressors.

Attempts to uncover the governing causes of behavior may benefit from eclectic forms of analysis due to the significant amount of variation in reactions to these stressors. This promotes the value of alternative viewpoints and different models to guard against stereotyped approaches by the sport scientist (Keogh, 1981). In fact, there have been many recent calls urging the development of alternative paradigms of analysis in sport studies (Gilroy, 1983; Silva & Parkhouse, 1982; Wright, 1983). The diffidence of science in recognizing new perspectives on existing sport problems, due to perceived incompatibility with older, established research practices, is a major rationalizing factor for this criterion.

Regarding the quest for normative data, Sharp (1982) reminds us that the aim of statistics in sport is to summarize, describe, and analyze. There is no doubting their value as an aid in experimentation, and yet the problem is that many alternative paradigms in studying sport behavior do not produce data of sufficient quantity or quality to lend themselves easily to sophisticated numerical analysis. For example, observational studies of aggressive behavior, gamesmanship, and transactional analysis, although constituting highly relevant issues for examination, have not been considered appropriate for producing a body of data that guarantees orthodox statistical treatment by the investigator. Instead, the quest for complex statistical analyses may actually direct the researcher toward a rather blinkered perspective of a problem and thus may be used as a "rather soft option" (Sharp, 1982, p. 37) when real issues go unexamined. Essentially statistical significance, in its own right, should not constitute a valued goal of experimentation but should serve as a means of providing an uncontaminated and comprehensive understanding of behavior in sport. In designing new experimental paradigms it is conceivable that statistics in sport psychology research may sometimes act more like a yoke to construct the view rather than as a powerful means of verifying probability.

A final example of this criterion concerns recent attempts to promote an eclectic perspective on the effects of anxiety on sport performance. Many researchers, by utilizing single measures taken at specific moments in time (e.g., Gal-Or, Tenenbaum, Furst, & Shertzer, 1985), have investigated how anxiety pervades competitive sport. This strategy has neglected how fluctuations may occur across time. However, on-line analysis has been considered a more realistic and efficient way of negotiating this question due to the recognition that the effects of the construct of anxiety may be better understood by taking an event-related approach. By utilizing a large time span for analysis, the distorting effects of isolated measures may be avoided since it is clear that an athlete's perceptions and cognitions may be prone to variations during the dynamic processes of learning, performance, and competition (Tenenbaum, 1985).

**Conclusion**

This paper has attempted a critical review and preliminary outline of the concept of ecological validity in relation to sport psychology. Hopefully, it has provided a stimulus for debate and argument on the true meaning of this concept,
which is currently lacking in the sport psychology literature. Clarification has revealed that it is unrealistic for ecological validity to imply that research should always occur during open analysis of performance, since the control necessary for truthful delineations of behavior may not be present. The main proposal of this paper is that experimental design should reflect proper, balanced awareness of the precepts of an internal validity and external realism. Paradigms that are dominated in an extreme manner by either complementary aim may fail to answer adequately questions of importance, or may produce data of tentative scientific value. Perhaps the best way forward is to isolate larger and larger components of contextually based sport skills or social interaction circumstances within a laboratory framework.

Criteria that highlight concern for realism (and component principles of behavior constancy and variable specificity), union, and eclectism may be useful in demonstrating the ecological validity of such experiments. This approach coincides with the comments of some investigators in emphasizing systematic, step-by-step programs for research in sport psychology (Allard, 1982; Fujita, 1982; Straub, 1980; Whiting, 1982). The movement from tight laboratory investigations to more open field studies, and vice versa, may optimally occur in structured research attempts in which individual strategies for action are not precluded by overspecific task limitations. Perhaps with this emphasis, sport science in general may proceed to help teachers, coaches, athletes, and researchers in dismantling reified assumptions that have existed in organized sport for the past 4 decades. Understanding the concept of ecological validity may be an important step in this direction.

References


