COGNITIVE ASPECTS OF PERFORMANCE

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ABSTRACT

The study of cognitive structures and processes in the control of skilled performance is considered and reviewed with special reference to a proposed hierarchical system incorporating levels of motor integration. Cognitive styles and dispositions of general behaviour are suggested as factors which may determine performance levels. The relative importance of these personal factors and stronger personality traits in accounting for variance in performance is considered in the light of a critique of the current interactional controversy.

INTRODUCTION

Knowledge and understanding of sports performance have until recently depended almost entirely on the researchers in the fields of applied biology, biomechanics and medicine. Major advances in, for example, the biochemistry and biomechanics of athletic performance have in the last few years greatly advanced scientific interpretations with respect to the selection, guidance and training of athletes, and have contributed no doubt to some of the current and dramatic improvements in performance. Only very recently, however, have researchers begun to unravel some of the psychological and psychosocial aspects which account for variation in athletic and sporting performance, especially in stressful situations. The huge increase in published research literature in new journals, books, and proceedings of national and international societies is a testimony to the developing interest in the psychological parameters of athletic behaviour which in the last analysis may be the crucial discriminators between success and failure in competitive sport. Although in this area issues concerning the acquisition of skills have long been debated in courses for physical education teachers and coaches, the emphasis has tended to be on pragmatic procedures which at best have relied on the application of knowledge speculatively collated from various areas of general psychology. In recent years, thanks largely to the stimulation and support of such scholars as Professor Alan Welford during his tenure at the Department of Experimental Psychology at Cambridge University, a much more specifically focussed programme of research into sports-based psychology has been discernible in this country and similar academic and research developments have mushroomed throughout the world. A milestone for coordinated international enterprise was the establishment in 1966 of the International Society of Sports Psychology, the first proceedings of which ran to over 1200 pages, giving a most comprehensive perspective to the new disciplinary area. Since then succeeding cohorts of teachers, researchers and writers have added sub-

stantially to our understanding of a wide range of psychological topics related to sports performance which in general may be said to encompass the interacting psychomotor processes categorised as cognitive, perceptual, affective and motor (cf. Singer 1975). The most recent history of significant advances has shown two not altogether related probes into what might be called the skill learning process and the personal/behavioural and situational factors that may account for success. Both are concerned fundamentally with the cognitive processes and it was, therefore, decided to focus on the current thinking and research which emphasises cognitive explanations and interpretations. Although such a device may appear to give some coherence to this paper, it is readily acknowledged that it must necessarily represent a restrictive and selective approach to interpreting current research, but any attempt to review a wider range of researches and issues would lead inevitably to superficial coverage and episodic reporting. The intention, therefore, is to consider briefly the cognitive processes involved in the acquisition of skill, before proceeding to a review of current work, both experimental and theoretical, which attempts to explain the effect on performance of personal dispositions and perceptions, which must necessarily incorporate a critique of the current trait v interaction controversy. The paper is divided into three sections — (1) Cognitive Structure and Skills Acquisition, (2) Personal dispositions, and (3) the interactional paradigm.

COGNITIVE STRUCTURE AND SKILLS ACQUISITION

Many researchers have suggested and elaborated on the notion of man as an information processing system. With respect to the acquisition of skills, Welford established the parameters for further study in his text *Fundamentals of Skill* (1968), in which he incorporated the basic processes of input, translation and output into a sophisticated model involving feedback loops, coding

procedures and short and long term memory stores (see fig 1).

Fig. 1: Hypothetical diagram of the human sensory-motor system showing some of the feedback loops.

Welford (1976) and many others (eg Whiting 1971 and Glencross 1978) who are centrally concerned with sports skills acquisition have continued to investigate the limitations associated with considering man as an information processing system, and the strategies that may be used to overcome these limitations. One of the major limitations that has been studied intensively is that concerned with capacity of the human information systems and the related slowness in processing information (see Legge and Barber 1976). In this connection Glencross (1978) summarises the central problem as follows: "In essence what needs to be considered is how an information dependent system which is relatively slow acting, develops into a fast co-ordinated and integrated highly complex yet "semi-automatic" system which still however is flexible and adaptable. Any discussion on the acquisition of skill must come to grips with an understanding of the transition from the unskilled performance of the novice to that of the highly skilled athlete, whose performance on the one hand is highly consistent, precise and predictable, and yet on the other is flexible and adaptable and able to cope with certainty about uncertainty."

Reviews of the recent research which go some way towards an understanding of this complex problem are available (see for example Posner and Keele 1976; Welford 1976; Legge and Barber 1976). For the present purposes attention is focussed on one of the more interesting of the current explanations of skilled performance as depending on an underpinning form of cognitive "plan" or "schemata". The notion is not new (cf. Tolman 1948 "Cognitive maps in rats and men" and Miller *et al.* 1960 "Plans and the structure of behaviour"), but its applicability to skilled performance has only recently been set down in a rigorous form. The motor plan or schema is according to Glencross (1978) to be regarded as a set of instruction or programme of action which determines the *general* sequence of events which got to make a skilled movement. This kind of plan for action is clearly necessary to minimise the theoretical

gap between intention and action, but the plan or schemata must be susceptible to modification on the basis of current sensory feedback and, therefore, the ultimate performances will depend both on the sophistication of the motor plan or schema and the quality of the information available to the performer. The concept is therefore much more flexible than the earlier ones which used the analogy of the computer programme. Neisser (1976) explaining the way the schema is modified continuously by the flow of information gives as an example the tennis player who must start with some notion of how the ball is to move after he has hit it. and

"Starting with this idea and also the objective state of affairs he acts, perceives the consequences of his actions, develops a more precise notion of what is to be done, acts again, perceives and again and so on until the final product is achieved."

A hierarchical organisation of cognitive structures that control skilled performance was proposed by Glencross in 1972. He suggested that in motor skills there is at the lowest levels the gradual building up of simple response units which give rise to motor plans and then broader based motor programmes, which in turn are under the control of a general executive strategic plan. When the motor plan is consolidated in a motor programme, the resulting movement patterns are highly reproducible and make minimal demands on the capacity of the human information system. More recently (Glencross 1977, 1978) he has elaborated on his model of the hierarchically organised central control process involved in skilled performance. The main elements of the model are as follows:

- (1) At the highest level is a superordinate "executive" system co-ordinating the lower level and eventually directing action to desired outcomes. It makes high capacity demands.
- (2) At the general level is a motor plan system determining the general features of a response in, for example, throwing and striking actions. It makes moderate capacity demands.
- (3) The motor programme level involves "constructions" of specific patterns of action which are superimposed in the motor plan, such as the general motor plan for striking becomes the specific programme for a forehand drive in tennis. This level is relatively automatic and makes small capacity demands.
- (4) The model includes a routine for the flow of information between levels so as to permit adaptations which explain fine tuning in a skilled performance.
- (5) Each level has the capability of functioning autonomously as well as functioning to effect changes in the others.

The practical implications of this kind of model for developing highly skilled performance centres on the development of strategies which facilitate the efficient flow of the most effective information, so as to reduce loading and uncertainty in the control system. These strategies, according to Glencross, may include, for example, (a) the circumventing of the normal processing delays by anticipating the response where it is reasonably certain the appropriate signal will occur; (b) the use of selective attention; the recognition of "whole patterns" rather than single cues; (c) the development of transformation rules to facilitate faster coding as in the coaching instruction to *throw* the racquet at the ball in tennis serving; (d) the formation of larger units of action so that after the initiation of a movement the subsequent phases take place almost automatically leaving the system "free" for other strategic purposes.

The preferred way in which the information is facilitated within the cognitive structure is manifested in an overall strategy of action. Welford (1976) has proposed that a strategy of action must properly adapt to both task demands (eg speed and direction of the ball) and personal demands (eg level of training and experience) if performance is not to suffer. Skill is the outcome of choosing the most efficient strategy from a range of possibilities available and clearly, as Welford points out, strategic solutions will be of a "coarse" variety in novel situations and be more refined when tasks are encountered on subsequent occasions.

PERSONAL DISPOSITIONS

A number of dispositions and cognitive styles have been proposed in the psychology literature over the past twenty years or so. Some of them have seemed to be particularly relevant to the context of sports performance, especially those that purported to assess the idiosyncratic perceptual style or achievement orientation which the performer brings to the task (see Harris 1973; Kane 1977). It is somewhat surprising to find so few rigorous researchers published in this area, having in mind the potential practical value of positive findings for coaches and teachers. While Witkin's field dependent — field independent perceptual style and McClelland's (1961) achievement motivation disposition have been widely quoted in texts for physical educationists and sports scientists, the applicability of neither has been demonstrable since little or no specifically oriented research has taken place. There would seem to be great scope here for budding research workers. In the hope of extending their repertoire of ideas beyond those noted in the reference above, this section of the paper will furnish brief commentary on four others; (i) self efficacy, (ii) imagery (iii) attentional styles, and (iv) intrinsic motivation.

Self-Efficacy: Bandura (1977) recently outlined a

theory of self efficacy, the central theme of which argues that the strength of an individual's convictions of his effectiveness determine the amount of effort and persistence he will apply to a task. Assuming that the individual is capable (for example, has sufficient skill) and is motivated, the actual performance according to the theory is likely to be predicted by the person's belief in his own competence relative to the particular task. One of the few studies relating the theory to sports is reported by Mahoney and Avenier 1977 in which they report a generally high self-efficacy expectation level for the USA men's gymnastic team, and moderately high correlation between pre-meeting self-confidence scores and actual performance. Many coaches are aware of the apparent appropriateness of this self-efficacy theory in reverse in explaining athletes' "sticking points". Athletes often perceive difficulty in going beyond a certain performance level, and only by some deception can they be enticed and convinced of their ability to perform at a higher level. In a similar way placebo studies in the areas of sports nutrition and drugs point to a gap between ability and performance that may well be explained by self-efficacy theory. The issue is clearly one that merits the careful collaborative investigation of the coaches and the behavioural scientists.

Imagery: Mental practice and mental rehearsal are well reviewed in the physical and education and sports literature. Corbin (1972) makes a cautious interpretation:

"There seems to be little doubt that mental practice can positively affect skilled motor performance, especially when practice conditions are "optional". It is equally clear however that mental practice is not always an aid to performance."

Apparently familiarity with the task and the timing of the mental practice are the two major factors which may affect the influence of this procedure. Mahoney & Avenier (1977) have also suggested that there may be two kinds of athletes when it comes to utilising imagery techniques — the ones who use "internal" (phenomenological) imagery, and the others who tend to use "external" (third person) imagery. These authors have reported tentatively on a positive relationship between internal imagery and success in gymnastics, and they have also suggested the wider use in skills learning situations of the "coping/mastery" models that are regularly used in cognitive-behavioural research.

Attentional Styles: Whilst the importance of selective attention has only recently been emphasised in the process of skills acquisition, the generalised importance of "paying attention" or "concentrating" throughout an athletic performance has long been recommended by coaches. Genov (1970) found that the outstanding weight lifter Zhabotinski increased his preparatory con-

centration time with each attempt at a heavier weight and gave more concentration time to the more complex lifts. Nideffer (1976) has investigated the attentional processes that regulate human behaviour and has suggested applications for sports performance. He writes:

"It is hard to imagine a variable more central to performance than the ability to direct and control one's attention."

His Test of Attentional and Interpersonal Style (TAIS) incorporates dimensions which distinguish between internal and external attention styles and between styles described as either broad or narrow. The TAIS scale measuring funnelled attention was found by the author to discriminate between consistency of performance among athletes.

From other studies (for example Fenz 1975) it seems likely that a strategy for shifting attention (especially from internal to external ones) may be particularly helpful in some stressful performances, and indeed may reduce arousal from high to optimal levels.

Intrinsic Motivation: The literature of psychology is heavy with theories and speculation about motivation. There is no intention here to try to unravel this confused area of psychology since this has been attempted with varying degrees of success and usefulness in earlier reviews (for example Kane 1972; Alderman 1974). The purpose is rather to direct attention to the attractiveness of intrinsic motivation as one developing interpretation of motivation which seems particularly suited to athletic experience and involvement. Although the terms of intrinsic and extrinsic have been commonplace in discussions of motivation for some time, the notion of intrinsic motivation has been elaborated in recent years to take account of a wave of interest in personality psychology that focuses on personal satisfaction, meaning, fulfilment, levels of consciousness, self-actualisation and joy. For those scientists, coaches and athletes who recognise that involvement in sports is not solely about successful performance but about inner feelings, experiences and satisfaction, this psychological approach deserves their careful attention. Its roots are in existential psychology and phenomenology and in such notions as, for example, "personal knowledge" (Polanyi 1958) and "needs of the mind" (Maddi 1970), which lay emphasis on unique knowledge derived by the individual from his perceptions in the course of satisfying his needs to understand himself. Maslow (1970) perhaps goes nearest to setting out a comprehensive, if speculative, theory to encompass the main elements of this psychological thrust which has sometimes been referred to as third-force psychology. Maslow categorised human needs into five sets which are placed in a hierarchical arrangement of importance and development, ranging from the lower level of physiological needs through those of

security, safety, belonging and respect, to the final caping monarchical need for "self-actualization". The self-actualizing person, according to Maslow, would have clear perceptions, be self-accepting, spontaneous, autonomous and natural, appreciate the basic qualities of life, have a deep affection and sympathy for all humans, enjoy peak experiences (ie mystical or transpersonal experiences) and know himself in order to maximize his potentialities. For Maslow self-actualization is regarded as the highest and most fulfilled state of human existence.

In somewhat more conventional psychological terms Deci (1975) touches on the processes involved in self-actualizing behaviour in his treatise on intrinsic motivation. Deci develops the model of intrinsically motivated behaviours as ones chosen by the person in the pursuit of "feeling competent" and "self determining" in relation to his environment. He assumes that in these pursuits the person has access to his own internal states (understanding, orientations, attitudes, etc) in a way which others cannot, and he effectively argues the importance of cognitions and experiences in changing the individual's internal states. Csikszentmihalyi (1975) investigating the inner experiences concerned with joy and pleasure in play games and life styles described a common form of experience enjoyed by the intrinsically motivated. He called this experience "flow" which incorporated feelings of exhilaration, of creative accomplishment and of heightened functioning. He writes, "they concentrate their attention on the limited stimulus field, forget personal problems, lose their sense of time and of themselves, feel competent and in control, and have a sense of harmony and union with their surroundings. To the extent that these elements of experience are present, a person enjoys what he or she is doing and ceases to worry about whether the activity will be productive or whether it will be rewarded."

One of the most common approaches today towards re-establishing the body as a sensitive vehicle for the recognition and enjoyment of feelings is running or jogging. The experience of runners of all kinds are being increasingly recorded and analyzed, and in the process accounts ranging from mystical and ecstatic interpretations to physiologically sensuous occurrences are to be found. On the back of a general revolution which has "rediscovered" the body as a source of awareness and vital sensation, running seems to be successfully competing with more elaborate practices involving bio-feedback mechanisms, various body therapies and even the martial arts as a means of generating and controlling inner states.

The dimensions of intrinsic states of being such as joy, delight and ecstasy are indeed hard to record, but their existence is undoubted. For those involved in sports activities at any level the intrinsic rewards and

satisfactions are clear and are unmistakably the product of a sensitized body.

THE INTERACTIONAL PARADIGM

For the past ten years or so a fascinating debate has been developing which goes to the roots of personality psychology, and reverberations have been felt in sports research. The importance of personality (ie personal and behavioural dispositions) in explaining performance difference has a long if somewhat misunderstood history of serious psychological research. Even in the area of sport performance the application of standardised personality tests has given some psychological insights that cannot be ignored (see for example Kane 1978, Morgan 1978). The standardised tests used (for example the Cattell 16PF and the Eysenck EPI) have purported to measure personality "traits" which are suggested as relatively stable dimensions. The "trait" approach to understanding the variance in performance is now under attack, not so much because it is unsound in theory or in practical application, but because personality traits emphasize only the personal dispositions in explaining behaviour and minimize the role of situational factors. As a result a number of alternative models and approaches have been proposed in an effort to explain a more vital and dynamic concept of personality, and the one most favoured at the moment is the *interactional* model which centres on the cognitive perceptions and interpretations of the person in a given situation.

An interactionist model of behaviour appears to be very much a matter of re-emphasis rather than one incorporating a new mode of thinking. As such, one wonders at the crisis proportions given to the current debate. Indeed the layman might be forgiven for assuming that to consider both the person and the situation in attempting to explain behaviour was common-sense. Moreover, interactionist explanations of behaviour go back quite a way in the psychology literature. Lewin (1935) it will be remembered, suggested the formula —

$$B = f(P,S)$$

where B refers to the behaviour resulting from a choice of possibilities or a performance measurement on a scale; where P refers to structural dimensions (physiological and psychological) represented in personality measures; where S refers to variable aspects of the situation and f refers to the functional relationship (or interaction between P and S in explaining B).

There has been a consistent flow of research since Lewin following his general interaction theory of behaviour, emphasizing from time to time different aspects of it. Present day interactionists like Mischel (1976) and Endler and Magnusson (1976) apparently wish to attribute over-riding importance in behaviour to the P x S interaction and support their case in two ways — by

theoretical postulates concerning the way a person construes a situation and by demonstrating the relatively large size of the P x S variance in select studies. The analysis of variance is the favoured tool to support the interactionist viewpoint and on the face of it the review of chosen studies by, for example, Bowers (1973) and Argyle (1976) are reasonably convincing demonstrating that person variance tends to fall into the 15-30 per cent range, situation variance into the 20-45 per cent range and P x S variance into the 30-50 per cent range. However, there are a number of unresolved design problems in these studies and Cartwright (1975) has suggested that many of them have been biased against discovering appreciable person variance, while Golding (1975) throws doubt on the appropriateness of variance analysis for seeking out person consistency across situations commending instead the use of Cronbach's coefficient of generalizability!

Nevertheless, the interactionist approach is of undoubted significance to sports psychologists. There has admittedly been a strong campaign over recent years by research workers in this field for the development of sport specific measures of behaviour and there has been a long standing recognition of the variable effects on performance of differing sporting situations, particularly where competitiveness and stress are involved. The attractiveness of interactionist explanations of behaviour seems therefore reasonably assured if only to complimentary trait descriptions. Some attempts to follow this line of thinking in sports research are in fact becoming increasingly evident, though Langer (1966) had earlier planned a model design for investigating behaviour and performance in different situations of sporting stress. The study monitored anxiety, as measured by the IPAT scale, of varsity footballers during the off-season (no stress), during the pre-game period (high stress) and immediately after the games (reduced stress) throughout the season and in concluding that anxiety level was a most important determinant of football performance Langer demonstrated the sensitivity of the IPAT anxiety scale for recording changes linked with levels of sporting stress and performance.

Another and more recent attempt to assess a person (trait) x situation model for anxiety in a realistic competitive athletic environment has been reported by Flood and Endler (1976). The measurement of anxiety was based on Spielberger's (1972) state-trait procedures adapted by Endler and Okada (1975) to account for their version of the multidimensional nature of trait anxiety in the anticipation of competition were reported, the results in general were equivocal leaving some doubt as to whether or not the interaction model of anxiety was supportable. In general one is left with some concern in this kind of "interactionist" study about the methods used for the assessment of personality dimensions. It is almost as if those seeking

support for the interaction model too easily and prejudicially discard well-standardized and reliable measures of personal dispositions in favour of superficial and less rigorously developed tests in their reaction against the former trait emphasis. This is a danger that those in sport psychology must avoid in calling for the development of sports specific measures of personality. The futility of employing hastily assembled adjective and observational check lists, questionnaires, self reports and the like should be all too obvious. It is gratifying to note in this connection few examples of sports specific measures which are being developed systematically with

sensitivity to the niceties and scientific rigours of test construction (for example Martens 1976). The problems in allocating the correct amount of importance to the Person, the Situation and the Interaction in sports performance will not be resolved easily or quickly, and certainly not by substituting sound and well-standardized measures of well-rooted personality dimensions for others less carefully developed and more superficial. Neither will full understanding of behaviour in sport be achieved by the facile shifting of theoretical perspectives to accommodate all the contemporary moods and "mini-theories" in psychology.

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