

SPORT AND PERSONALITY

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1. INTRODUCTION

There is a large literature on the topic of "sport and personality", much of which is, unfortunately, of an unacceptably low scientific standard. Many of the results reported are contradictory and difficult to interpret, particularly because of the small sample sizes often involved. There has been an alarming failure to consider the complexities of the topic, to allow for the weaknesses and deficiencies of many existing personality questionnaires, or to make distinctions which are absolutely crucial in this field, e.g. between outstanding and average practitioners of a given sport, or between different types of sports, such as individual versus group sports. Last but not least, there has been little effort to consider the relationship between sport and personality in theoretical terms, i.e. to try and elucidate the possible relationships in terms of causal factors that might be mediated by differences in personality.

Clearly a beginning must be made by considering the concepts involved in the title, i.e. "sport" and "personality". Both, while appearing obvious at first sight, present considerable difficulties of definition and conceptualisation. Let us consider *sport*, to begin with. This is defined in the Concise Oxford Dictionary as "amusement, diversion, fun; pastime, game; outdoor pastime". The Collins English Dictionary defines it as "individual or group activity, pursued for exercise or pleasure, often involving the testing of physical capabilities; any particular pastime indulged in for pleasure; the pleasure derived from a pastime". These definitions are so inclusive as to rule out very little. Should sexual activity be regarded as a sport? Certainly sexual activity is often discussed in sporting terms and Japanese artists have published series of paintings of a "sexual Olympiad". The point is not made as a humorous aside; as we shall see, the relationship between sexual attitudes, behaviour and personality (Eysenck, 1976) is in many ways similar to that which exists between personality and other types of more orthodox sporting activity.

However we may define sport, it is unlikely that many relationships will be established between personality and *all* types of sporting activity. At least two major dimensions need to be looked at in detail with regard to sports. The first one relates to the *type of sport*. Some are highly *individualistic*, like long distance running, or sculling, while others are clearly *team* activities, like football or ice hockey. It cannot be assumed that identical personality patterns will be apparent in participants in these two quite different types of sporting activities; possibly individual sports attract the more introverted, group sports the more extraverted. Even within a group sport, however, there may be differences; forwards in football may be more extraverted, goal keepers more introverted. In an unpublished paper, Butt (1980) compared a number of top level female hockey teams on the basis of questionnaire responses; she found *inter alia* that forwards, as compared with defence players, were less socialized, more aggressive, had less behavioural control and were less autonomous. All these comparisons were statistically significant at the 0.05 level, but the differences were never large in absolute terms. If results are averaged over heterogeneous groups, important information may be lost. Unfortunately most studies in the literature have done precisely that, possibly because the numbers involved were too small. However, in looking at the detailed results later on, this point should always be borne in mind. Sex differences may also be important, (Popma, 1980; Block *et al.* 1973; Butt and Schroeder, 1980); there are

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suggestions in the literature that women are more successful and better adjusted to sport achievement if their personality resembles more closely that of the male. Results should always be kept separate for the two sexes.

Another difference that ought always to be considered is the distinction between *outstanding* performers in a given sport, and the *average* player or participant. Again, we cannot assume that the personality picture of the outstanding sportsman, as compared with non-sportsmen, would be similar to that of the average participant in the same sport; it is possible and even likely that outstanding achievement is mediated by special personality features which are not shared by the average participant. There is, indeed, some evidence to suggest that this is an important difference, but again many of the published studies have disregarded it, perhaps for the same reason, namely difficult access to appropriate subjects resulting in small samples. We thus have at least a fourfold cross-classification of sportsmen, involving outstanding individual athletes, outstanding participants in group sports, average individual athletes, and average participants in group sports. Some personality traits may discriminate between sportsmen and non-sportsmen, while other traits may discriminate between members of the four sports groups (Dowd and Innes, 1981). Future research would be well advised to keep in mind these important distinctions, and to employ large enough samples to make possible cross tabulations in relation to personality.

2. MEASUREMENT OF PERSONALITY

Personality is an equally slippery concept, and even though most workers in the field have agreed to use some form of *dispositional* concept involving traits, attitudes, and types, nevertheless many points at issue remain unresolved. Trait psychologists share certain preconceptions which have found ample support in the empirical literature; they will just be noted here in brief. 1) Individuals differ with respect to their location on important semi-permanent personality dispositions, known as "traits". 2) Personality traits can be identified by means of correlational (factor analytic) studies. 3) Personality traits are importantly determined by hereditary factors. 4) Personality traits are measurable by means of questionnaire data. 5) The interactive influence of traits and situations produces transient internal conditions known as "states". 6) Personality states are also measurable by means of questionnaire data. 7) Traits and states are intervening variables or mediating constructs that are useful in explaining individual differences in behaviour to the extent that they are incorporated into an appropriate theoretical framework. 8) The relationship between traits or states and behaviour is typically indirect, being affected or "moderated" by the interactions that exist amongst traits, states, and other salient factors. This general view of personality has been criticised by Mischel (1968, 1976, 1977) and others; a reply to these "situationalist" attacks has been made by Eysenck and Eysenck (1980).

It is fairly widely agreed that trait concepts of personality are *hierarchical*; in other words, correlations found between certain behaviours define traits (such as sociability, impulsiveness, worrisomeness, aggressiveness, assertiveness, persistence, etc.), and observed correlations between these "primary" traits generate second order or superfactors, often called "types". Royce (1973) has exhaustively analysed the existing literature, and has shown that there are three major superfactors which emerge again and again from different studies, in many different countries. These three superfactors are variously labelled by different authors, but will here be referred to as extraversion-introversion (E), neuroticism-stability (N), and psychoticism-superego function (P). For a detailed discussion of the psychometric background of these factors, Eysenck and Eysenck (1969, 1976) may be consulted.

The nature of these three superfactors can be looked at descriptively or causally. From the descriptive point of view, the nature of E and N is probably well enough known amongst psychologists, and is roughly delineated in Fig. 1, which shows the major traits characteristic of opposite poles of these continua. The four quadrants thus generated bear the names of the traditional personality types originally put forward by the Ancient Greeks. Psychoticism-superego function is perhaps less widely known, and it may be useful to state briefly the traits

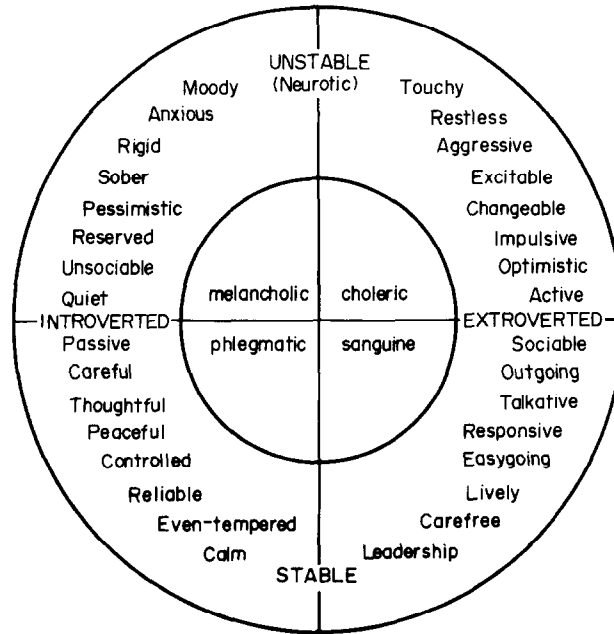


FIG. 1. Two major dimensions of personality (introversion-extraversion, neuroticism-stability).

characteristic of the two opposing poles. The high P scorer is egocentric, cold, non-conformist, aggressive, impulsive, hostile, suspicious and antisocial. At the opposite end we have cooperative, empathic, caring, and highly socialised traits. High P scorers tend to be male, low P scorers female; groups scoring high on P are psychotics, criminals, and drug takers. Like E and N, P also has a strong genetic component; for all three super-factors, genetic factors account for about three quarters of the total variance, environmental factors for one quarter. The environmental variance is almost exclusively within-family, rather than between-family, and non-additive genetic factors like dominance and assortative mating play hardly any part in the genetic architecture of these personality factors (Fulker, 1981).

On the causal side extraversion-introversion has been associated with the level of cortical arousal as mediated by the reticular formation; at the resting level introverts have higher levels of cortical arousal than extraverts. N has been associated with the activity of the limbic system (visceral brain), and the autonomic system in general; high N scorers have more labile and longer autonomic reactions than do low N scorers. P has been associated with the male hormone system (androgens) as well as with the relative absence of serotonin metabolites like 5HIAA, and the presence of leucocyte antigens like HLA-B27, which are known to be particularly strongly represented in psychotics. Detailed accounts of these causal factors will be found in Eysenck (1981a) and Eysenck and Eysenck (1976).

Before turning to the question of what predictions can be made on the basis of our fairly extensive knowledge, both descriptively and causally, of these three superfactors, we must consider the alternative approach to the measurement of personality, namely the "multiphasic" approach (as exemplified in the Minnesota Multiphasic Personality Inventory (MMPI), or quite generally the multi-trait approach, as used in the Cattell's 16 Personality Factor (16PF) scales, the Gough California Psychological Inventory the Guilford-Zimmerman Scales, and many others. While these scales, when themselves intercorrelated tend to produce second-order factors similar to P, E, and N (Wakefield *et al.*, 1974; Eysenck, 1978; Eysenck and Eysenck, 1969; Nichols and Schnell, 1963), It is often suggested, most strongly by Cattell, that the major contribution to predictive variance is made by the primary (trait) factors, and that it is these that should be used for prediction, selection, etc. There are two reasons for doubting whether this advice is sound. In the first place, studies comparing the predictive validity of traits and type-concepts have shown that practically the total contribution to prediction or explanation is made by the type-concepts or superfactors (Reynolds and Nichols, 1977); there is no evidence that trait measures add

specific variance to that contributed by the superfactors, which is itself predictive of important social behaviour or activities.

Second, and even more important, is the sad failure to replicate many of the traits so confidently asserted to exist on the basis of factor analytic studies. Cattell's 16 personality factors may be used as an example; they have been confidently asserted by him to be "source traits", and to be the most firmly secured in a large number of factor analytic studies. Furthermore, they have been used in many investigations trying to relate sport and personality. Eysenck (1971, 1972) has reviewed some of the evidence relating to the replicability of the Cattell factors in factor analytic investigations carried out in many different countries, and has come to the conclusion that the studies reported by Comrey and Duffey (1968), Greif (1970), Howarth (1972) and Howarth and Browne (1971), Levonian (1961), Peterson (1960), Sells *et al.* (1968, 1970), and Timm (1968) (see also Bolton, 1977), entirely failed to give support to the Cattell factors, as does the large-scale work of Eysenck and Eysenck (1969). What is often found is that items originally allocated by Cattell to one factor have much higher loadings on other factors, and that in many cases there is no evidence at all of item homogeneity for many of the factors isolated by Cattell. Furthermore, the identification of the factors has rightly been queried (Howarth, 1976), and the heterogeneity of items on many of the factors is such that when trained psychologists were asked to match the items constituting the various factors with the trait names given them by Cattell, they failed in doing so (unpublished investigation). These results must throw grave doubts on the meaningfulness of these traits, and *a fortiori* on the meaningfulness of traits reported by other investigators, backed by less extensive work than that of Cattell and his associates.

These considerations are important in selecting a personality inventory for the investigation of personality in sport (Eysenck, 1971); they are also important in interpreting the work reported by psychologists who have chosen instruments which in line with the arguments presented above are suboptimal. Unfortunately, the reviewer cannot pick and choose; he is forced to deal with material that has been reported in the past, and although he may regret that better instruments have not been used, he must attempt to take from the published evidence as much information as is possible, in spite of the inadequacy and the weaknesses of the instruments employed. This is what has been attempted in this paper, but inevitably the implication is that judgments become more subjective than one would wish, and interpretation has to be made of findings which are dubious because of the weaknesses indicated.

3. THE CAUSAL NEXUS

We have discussed the general descriptive framework of the personality theory in terms of which this monograph is organized, and we have described the physiological and hormonal basis of the behaviour patterns described. We must now ask ourselves just precisely how these biological inherited differences in reticular formation, limbic system and hormonal functioning can be translated into concepts of a behavioural kind directly relevant to sporting activities. In this connection it is useful to consider Fig. 2, which delineates the relationship between level of sensory stimulation (or the various collative properties identified by Berlyne, 1960), and hedonic tone (Eysenck, 1963). The general form of the curve describing the results of numerous experiments was already suggested by Wundt; it approximates the solid line in the diagram, i.e. sensory stimulation that is too low (sensory deprivation) or too high (pain) is equally disliked (negative hedonic tone), while intermediate levels are preferred (positive hedonic tone).

Extraverts and introverts will depart from this general curve in opposite directions, by virtue of the intensity modulation imposed on them by the low or high level of cortical arousal present. In the terms used by Petrie (1978), introverts are *augmenters*, extraverts *reducers*; in other words, the former, because of their high level of arousal, amplify incoming stimulation (augmentation), while the latter, because of their low level of arousal, reduce the intensity of incoming stimulation. Thus at a given level, A, where the ambivert is indifferent,

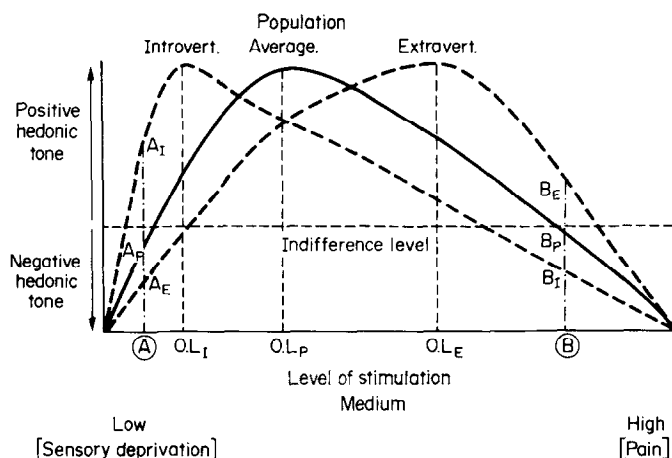


FIG. 2. Relation between level of sensory stimulation and hedonic tone.

introverts would experience positive hedonic tone, extraverts negative hedonic tone. Conversely, at point B, extraverts would experience positive hedonic tone, introverts negative hedonic tone. In general, the optimum (preferred) level of stimulation of introverts is to the left of the general population ($O.L._I$), that of extraverts to the right ($O.L._E$); the optimum level of the generality is designated $O.L._P$.

Certain obvious predictions follow from this argument, such as that introverts would be able to stand sensory deprivation better than extraverts, but that extraverts would be able to stand pain better than introverts. For both predictions there is ample experimental evidence (Eysenck, 1967, 1981a).¹⁾ We may also deduce certain motivational consequences from this Figure. Assuming the general correctness of the law of effect, or the principle of reinforcement, individuals would be motivated to increase stimulation when underaroused, and *decrease* stimulation when overaroused; boredom, under conditions of too low arousal, and pain, under conditions of excessive arousal, are known to be powerful motivating factors. Thus we would expect extraverts to seek out strong sensory stimulation, introverts to avoid it.

Generally, then, we may say that individuals possess unique perceptual styles through which they organize and interpret sensory input in a particular way. We tend to seek out those sensory environments that are conducive to optimal functioning. As a means to assessing the implications for personality differences resulting from the concept of "an optimal stimulation level" (Leuba, 1955; Berlyne, 1960; Eysenck, 1967), Zuckerman and his co-workers developed the Sensation-Seeking Scale (Zuckerman, *et al.*, 1964). Sensation seeking is a trait characterized by a need for varied, novel, and complex sensations and experiences, and the willingness to take both physical and social risks in order to have such an experience (Zuckerman, 1979). The high sensation seeking individual is described as being oriented to bodily sensations, thrill-seeking, active, impulsive, antisocial or nonconformist, and low on anxiety (Zuckerman and Link, 1968). As would be expected, this trait is correlated with extraversion, and constitutes one of the primary traits supporting the higher order concept. The high level of physical activity the extravert typically engages in thus seems to be designed to fulfill an excessive need for stimulation.

Furnham (1981) has carried out an experimental study whose aim it was "to determine whether different personality types choose and avoid different social situations in which to participate". he found that "the introversion/extraversion factor consistently produced significant effects over actually experienced leisure activities and hypothetical needs/press activities, abstractly described social situations and specific difficult social situations. A number of, though not as many, significant differences occurred along the neuroticism

¹⁾Detailed studies linking extraversion with pain tolerance are reported *inter alia* by Haslam (1967), Lynn and Eysenck (1961), Morgan and Horstman (1978), Mumford *et al.* (1973), Petrie (1978), Ryan and Foster (1967), Ryan and Kovacic (1966), Shiomi (1977, 1978, 1980), and Sweeney and Fine (1965).

factor ... Extraverts appear to seek out stimulating social situations including those which involve assertiveness, intimacy and competitions more than introverts while neurotics tend to avoid situations involving competition or social interaction. Nearly all of the results are explicable in terms of Eysenck's personality theory." (p. 57.)

Farley (1973) has extended this model of stimulation seeking to consider the environmental opportunities which exist for the satisfaction of this need. If the environment does not provide a variety of socially acceptable experiences, then there is an increased likelihood that the individual with a high need for stimulation will ultimately engage in antisocial behaviours, which provide the stimulation he requires. Supporting this position is an extensive literature which indicates that those who experience a high need for stimulation are indeed at greater risk for antisocial activity (Eysenck, 1977; Zuckerman, 1979; Cox, 1979). The three models of sensation seeking considered — Zuckerman's, Eysenck's, and Farley's — all argue that this need is, at least in part, the result of a physiological arousal deficit. As described earlier, those who have a high need for stimulation are motivated to raise their arousal levels, whereas individuals high in physiological arousal will tend to avoid stimulation in order to reduce their arousal levels. It may be possible to control or alleviate excessive stimulation seeking by providing the opportunity to engage in highly stimulating, exciting and perhaps risky activities. Some of the characteristics attributed to the high sensation seeking, and perhaps ultimately antisocial, individual might be expected to enhance performance in some of these activities. One such outlet, which would appear to be both effective and socially acceptable, is sport. In reviewing the literature this position is supported both empirically and anecdotally.

Young and Ismail (1978) report that, even at the simple level of physical fitness, it is possible to distinguish between individuals of high and low fitness levels on the basis of biochemical and personality variables. Among the traits which consistently distinguished those who were physically fit were adventuresomeness, social boldness and unconventionality.

Empirical research has identified numerous traits which coincide with athletic ability, many of which would be expected to correlate highly with the need for stimulation. For example, the following are consistently cited: tough-mindedness, venturesomeness, extraversion, increased pain tolerance, high need for achievement, aggressiveness, low levels of tension, dominance and high energy levels (Neal, 1963; Kane, 1968; Malumphy, 1968; Ogilvie, 1968; Cooper, 1969; Fletcher and Dowell, 1971; Tattersfield, 1975). Risk-taking, an important constituent of extraversion (Vestewig, 1977), is obviously also relevant here.

As Zuckerman (1979) acknowledges, surprisingly little research has examined the personality traits of those participating in high arousal sports. Hymbaugh and Garrett (1974) found skydivers to be significantly higher on the SSS than non-skydiver controls. Zuckerman (1979) reports on a drug rehabilitation programme in which graduates had taken up parachute jumping. He suggests that for those who have pursued excitement in illegal or personally harmful activities, sports such as skydiving offer an outlet to experience the "high" of arousal in a legal, relatively low risk manner.

Csikszentmihalyi (1975) describes the experiences of expert rock climbers, who generally accept the danger involved in the sport as part of the total experience, in which their competence predominates over the voluntary risks of the situation. He reports that, in the sample he examined, the majority did not consider rock climbing to be dangerous and many, intriguingly, felt it was less dangerous than everyday activities, such as driving a car or walking down a street. Similar results are reported by Lefebvre (1980) who studied inexperienced climbers.

A recent quote attributed to Steve Podborski, a leader in men's downhill ski racing, further emphasizes the stimulation derived from this combination of danger and control. He states:

"The only thing I want to do when I go fast is to go faster. Just imagine yourself in the point where you are scared silly. You get tunnel vision, and the only things you see are the absolute necessities to maintain life. I'm never afraid ... I think I can handle any pain that comes along, so there is not much to fear." (The Sunday Times, February 8, 1981).

This attitude seems to be typical of many who are successful at high speed sports such as skiing or motor car racing.

Also of interest is the extent to which the extraverted, sensation seeking individual will find questionable tactics within sport more acceptable, if only because engaging in such methods will result in an increase in arousal. Paulhus, Molin and Schuchts (1979) found that with tennis and American football players there was a significant correlation between an athlete's success, his individual proficiency rating and his belief in Machiavellian tactics. This trait designates a willingness to use duplicit interpersonal tactics and individuals high on it might be expected to push the rules to the limit for personal gain. The use of strategies designed to upset an opponent's performance, while resisting emotional involvement, would be expected to provide an advantage in most sports.

The extreme example of such a manipulation must be the use of intimidation through violence, which appears to be openly condoned in some sports; e.g. Smith (1979) has examined the use of violence in Canadian ice hockey. Although fighting and forms of assault other than body contact are discouraged, they become important components of skill evaluation as young players move closer to professional levels. Coaches are sensitive to a player's ability to withstand and reply to physical coercion. It is acknowledged that some players progress upwards primarily because of their ability to fight. Professionals appear to be approving of on-ice assaults (Smith, 1975), and toughness and a willingness to fight are important in establishing a positive identity. In ice hockey there exists an occupationally oriented violent subculture which is operative mainly in the highly competitive leagues, where professional criteria regarding the use of violence exist.

This attitude may not only be present in body contact sports but, rather, be an increasingly prevalent aspect of all competitive sports. The arousal which results from even momentarily disturbing an opponent may be a crucial component of the often invoked "killer instinct". Patmore (1979) has provided an interesting analysis of the psychological duel that is part of the confrontation between the batsman and bowler in cricket (that gentlemen's game which gave rise to the phrase "it's just not cricket" to designate those acts which fall outside the bounds of fair play). Part of the intimidation used by the bowler, particularly at the first class level of the game, is that he may attempt to hit the batsman with a ball often travelling in excess of 90 mph. At this speed there is little that the batsman can do to save himself. She provides a quote attributed to fast bowler Jeff Thompson, which is as follows:

"I enjoy hitting a batsman more than getting him out. It doesn't worry me in the least to see a batsman hurt, rolling around screaming and blood on the pitch."

His teammate Dennis Lillee is known to work himself into a state of intense hatred with the support of Australian cricket fans who willingly chant, "kill, kill, kill" when he bowls. Such attitudes suggest a high degree of aggressiveness and cold egocentricity which is the hallmark of P.

Specifically with respect to antisocial behaviour, attempts have been made to channel individuals towards sport as a form of prevention. However, as Layman (1974) points out, for some people antisocial activities will be more stimulating than that which is typically offered in recreation programmes. It is recommended that a variety of activities be provided and that attempts be made to deal with the unique needs of the individual. To this end programmes involving severe physical challenge have been designed to deal with delinquent youth. These programmes, which include activities such as rock-climbing, hiking and learning wilderness survival skills, appear to have their greatest impact in reducing social alienation and increasing assertiveness (Reid and Matthews, 1980). The problem with this approach is that it involves a limited timespan. For the individual with a high need for stimulation such experiences will only be successful for their duration. Upon returning to the home environment, the need for stimulation still remains; however, it may now be accompanied by newly developed leadership skills.

With respect to the need for stimulation it would appear that, not only do sports serve as a successful and appropriate channel for this need, but that, if given such an opportunity the individual with a high need for stimulation may have personality traits that will increase the likelihood that he will be successful in such activities.

Our analysis thus suggests that extraverts (and high P scorers) are more likely to take up sports, and to excel in them, because their low arousal level leads them to seek sensory stimulation through bodily activity (sensation seeking). Equally, they will be more venturesome and risk-taking — behaviour possibly leading to danger obviously increases arousal more than conventional, safe behaviour. Extraverts, again through their low arousal level, tolerate pain better, and are hence better equipped to deal with the often painful consequences and side-effects of sporting activities. In view of all these considerations, we would accordingly expect sportsmen to be more extraverted than non-participants in sport, and to find leading sportsmen to be more extraverted than average participants.

As far as neuroticism is concerned, the position is complicated by the fact that anxiety, most frequently found in high N scorers, can act as a drive (and hence facilitate performance), but may also have the qualities of a drive stimulus, to use Hull's term, and thus distract the person involved from proper reactions to sensory stimuli involved in optimal performance. Eysenck (1973) has discussed the extensive literature on this topic in detail; he has also tried to outline its implications for sport (Eysenck, 1968, 1979). Most relevant is the well-established Yerkes-Dodson Law, which has two parts. The first states that the relation between drive and performance is *curvilinear*; increasing drive is effective in increasing performance only up to a point. Beyond that point, increasing drive becomes counter-productive and performance becomes worse. The second states that this optimal point occurs earlier for more complex tasks; in other words, increasing drive strength is likely to work only when we are dealing with relatively simple types of physical or mental performance. With more complex types of activity, increasing drive soon interferes with performance.

An alternative interpretation of the Yerkes-Dodson Law has been given by Spence, whose extensive work is reviewed in detail by Eysenck (1973). He argues that simplicity and complexity are not the relevant variables, and instead suggests that the crucial variable is the *habit strength* of the skill to be learned. If this is strong, then increasing drive to almost any degree will facilitate performance (always excepting the deleterious effects of the drive stimulus properties of anxiety). If, however, habits different from, or contrary to, that to be practised are strong, then an increase in drive will multiply with the wrong habit, and will make the acquisition of the new habit more difficult. Clearly, a very complex analysis has to be undertaken in each case before a prediction is made, and too general statements about N should be discouraged. Nevertheless, in the case of highly practised sportsmen, the major variable in question will undoubtedly be the distraction produced by drive stimuli, and these should always have a negative quality as far as achievement is concerned. Drive stimuli, however, are only likely to be experienced when anxiety is high; with lesser degrees of anxiety the drive properties are likely to predominate. We are thus led to predict a curvilinear correlation between sports activity and N; too low N makes for poor motivation, too high N for distraction. Unfortunately, most investigators have simply looked for linear correlations; had they analysed the problem along the lines of Spence's theory, they might have been able to report more positive results, based on a better understanding of the complexities of the situation. Future work should certainly be undertaken only after a proper theoretical analysis of the total situation, and appropriate curvilinear statistics (such as *eta*) employed.*

As far as psychoticism is concerned, predictions are fortunately rather more simple, as in the case of extraversion. One would expect high P scorers to have an advantage over low P scorers, insofar as aggressiveness, antisocial behaviour, and impersonal attitudes are likely to bestow an advantage on a player in most sports. We have already quoted some well-known sportsmen indicating the high level of aggressiveness which characterises their behaviour. In other words, if aggressiveness is a necessary or desirable trait in leading a sportsman to win, then P will be correlated positively with success.

*A detailed discussion of the various theories in question, with special reference to sport, is given by Martens (1977), who also presents his special Sport Competition Anxiety Test, and quotes a number of empirical studies in an attempt to validate this test. He concludes in favour of some form of inverted-U relation between anxiety and success. His presentation and empirical work employ both trait and state measures of anxiety, and look at both pre- and post-competition scores.

4. RELATION BETWEEN PERSONALITY AND SPORT

An excellent survey of the early literature on the relationship between sport and personality is given by Sack (1975), in a book which also contains his own extensive studies and analyses. His attitude, which is both critical and sceptical, presents a welcome relief from the atheoretical empiricism which often characterises research in this field. Sack quotes a study by Slusher (1964) who compared five groups practising different kinds of sports, who filled in nine MMPI scales and a scale of intelligence. As he points out, there result ninety comparisons which are difficult or impossible to interpret. What can one make, for instance, of the fact that basket-ball players score higher on the depression scale than swimmers, but lower on the neuroticism scale? This type of work is not easy to interpret, because no theories are being tested, and the larger number of comparisons involved makes it almost necessary that a number of "statistically significant" results should be found which are in reality simply chance differences occurring no more frequently than once in twenty comparisons made.

Sack's analysis of the literature contradicts surveys carried out by Cooper (1969), Cowell (1960), Gustad (1952) and Ogilvie (1970), who attribute more importance to personality factors than does Sack Himself. Kroll (1967) and Rushall (1970) agree with Sack in his estimate, but go counter to the views expressed by Layman and McCloy (1970) and Scott (1960), whose theories lead them to expect more positive results.

Sack is undoubtedly correct in his critical stance, but his conclusions seem to be in contradiction to a good deal of the evidence, when this is considered from a proper methodological and statistical point of view. His own work may illustrate why some negative results may be due to factors in the design of the experiment, and cannot be generalised too broadly.

Sack's own work was concerned with middle and long distance runners, of both sexes; this in itself limits very crucially the application of his findings. As we shall see, both from the points of body-build and personality long and middle distance runners are more introverted, and ectomorphic, than are short distance runners, who are more extraverted and mesomorphic. Thus the choice of subjects may already prejudice the results; if one were testing the hypothesis of extraversion as being a crucial trait in sport, then this choice of subjects would lead one to predict a rather smaller correlation than would be found with many other groups of sportsmen and women. A much more varied group of sportsmen and women should have been chosen in order to test such an hypothesis.

In the second place, the questionnaire used by Sack (the *Freiburger Persönlichkeitsinventar*) was reduced to a shortened version which excludes the extraversion and neuroticism scales; yet it is these scales which in theory would contribute most to the correlation with sporting activity! Clearly the choice of questionnaires has loaded the dice very much against finding the kind of relationship which theory would have led one to expect. It would have been far better had Sack chosen as his instruments some of the tests regarded more widely as crucial measures of extraversion and neuroticism. In the third place, Sack's study contains no measures of psychoticism, or any of the primary factors contributing to this second order variable. Given that the theory suggests that P contributes an important component to the total personality picture of the successful sportsman, such an omission, while understandable at the time the investigation was planned, makes it more difficult for us now to take the negative results too seriously. Even so, and in spite of these difficulties, Sack found quite a significant contribution of personality factors to differences between sportsmen and non-sportsmen, amounting to something like 7% of the total variance for men and women together, and a rather smaller amount of variance (4%) accounted for in relating personality and sporting achievement. Personality factors also contributed over 7% to a differentiation of sporting activities between runners and players of handball or football. Given the restrictions imposed by Sack's design and choice of measuring instrument, these results suggest that personality may play a larger part in relation to sport than Sack acknowledges.

A study in some ways similar to that of Sack is one of Fiegenbaum (1981) who compared 52 controls with 53 runners and 62 joggers; runners were defined as having had times less than 3 hours and 30 minutes for running the marathon, whereas joggers had either not run a marathon at all, or had times longer than this. Fiegenbaum also used the FPI, but included

scales for extraversion, emotional lability and masculinity, corresponding roughly at least to E, N and P. The results of her study are given in Table 1; it will be seen that in all three comparisons runners, joggers, and controls come in the predicted order, with runners being more extraverted, less labile, and more masculine than controls, and joggers being always intermediate. Clearly even with the least promising type of sportsmen, replicable results in line with prediction can be produced.

Rather more decisive than these studies of relatively low level participants is an unpublished study of 192 Olympic athletes who were given the EPQ.

Their scores, compared with those of a control group of 500 male non-athletes, are given in Table 2. It will be seen that the athletes have higher E scores, lower N scores, and high P scores; thus on all three personality scales they are differentiated from the controls in the expected direction. The fact that on the L (lie or dissimulation scale) the athletes come out lower than the controls suggests that the lower N scores are not due to dissimulation, but represent a valid picture of the athletes, and that the difference might be even larger had correction been attempted for L.

An alternative interpretation of the L score would be in terms of conformity (Eysenck and Eysenck, 1976); on this interpretation athletes would appear less conformist than non-athletes. As we have seen, this personality characteristic has been associated with athletes by other authors, and may constitute a fourth leading characteristic of this group.

The observed differences on P, E, N and L are not very large, taken separately, although of course they are all fully significant and in accordance with theory, but it should be remembered that the variances associated with each comparison are additive, in view of the independence of the four factors. Thus while the contribution made by each factor may not be very large, that made by all four together would be quite appreciable, and certainly of practical predictive value. It should also be remembered that the Olympic athletes whose contribution is summarised here came from many different types of sport, and as we shall see there are significant differences between different sports, as far as personality is concerned, and even within a given sport, such as shooting, when different varieties of shooting are looked at. Thus the observed differences are minimal differences, and much greater differences would be expected if more specific comparisons had been undertaken.

One of the most interesting published studies is reported by Cattell *et al.* (1970); the results are reported in Fig. 3. Their report deals with olympic athletic champions, football players, and male and female swimmers. To understand it, it is necessary to have in mind the descriptive system employed by Cattell, and accordingly we reproduce below his definition of the various traits in his system, repeating, however, the warning that these factors have been found difficult to replicate, and that their meaning is not as clear as would appear in the confident wording of the descriptions (Table 3).

Cattell's interpretation of the figures is that "the profile for Olympic athletes shows high ego-strength, dominance, low superego, and an adventurous temperament, and it seems

Table 1. Scores on extraversion, emotional lability and masculinity of runners, joggers and controls. From Fiegenbaum, 1981

	Extraversion	Emotional Lability	Masculinity
Runners	3.65 \pm 2.06	1.40 \pm 1.41	5.44 \pm 1.17
Joggers	3.09 \pm 2.03	1.86 \pm 1.60	4.96 \pm 1.34
Controls	2.46 \pm 2.19	2.22 \pm 2.25	4.67 \pm 1.99

Table 2. P, E, N and L scores of 500 controls and 192 Olympic athletes

	500 Controls	192 Olympians
P	2.48 \pm 2.08	3.77 \pm 2.74
E	12.56 \pm 4.76	14.60 \pm 4.31
N	8.40 \pm 5.02	7.43 \pm 4.68
L	7.93 \pm 3.97	6.47 \pm 3.83

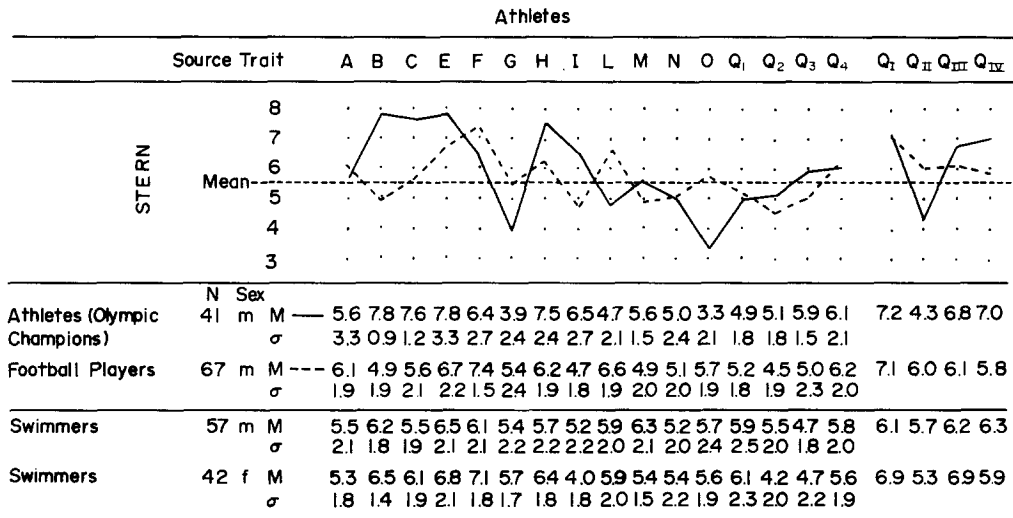


FIG. 3. Personality scores of various athletic groups, in relation to population means, on the Cattell 16PF scales. (Cattell *et al.*, 1970.)

clearly to define what one would expect in a group of championship athletes ... The low proneness to guilt feelings and little sense of inadequacy also seems to fit with the picture of a group of persons who have achieved outstanding success. Among the secondaries, their outstanding characteristics are high extraversion, cortertia, and independence, and low anxiety. Attention is called to the similarity between this profile and that of airline pilots." (p. 193.) (In the Cattell system, cortertia is the opposite of pathemia, and denotes "tough poise" as opposed to sensitivity and emotionalism.)

Cattell goes on to say that "the swimmers and college team football players stand in the same general personality category, but with less extreme scores. The high extraversion is modified in champion swimmers who share their high dominance and surgency, but are otherwise ... not so exviant." He adds that "some interesting specific features also appear in the footballers, with lower intelligence, definite harria, praxernia, and group adherence. this is a profile of an alert, action-oriented, practical, dominant, group-dependent type, actually very close indeed to what has been long prescribed for a good football team player." (p. 193.) (The term harria refers to tough-mindedness; praxernia to practical concerns.)

In general, it might be said that the impression given by these results is of groups of stable, extraverted young men and women, and that the outcome resembles the general prediction made in the previous section. Note in addition the lack of sensitivity, and the presence of "cortertia" and the general independence, suggesting lack of conformity; these probably relate to the P factor in Eysenck's system. Thus the general data suggest a group of people high on E, low on N, and probably high on P. Interesting as these data are in confirming predictions, we should note the relatively small numbers involved, and the fact that only certain sports have been covered. Nevertheless, the data are interesting and relevant.

The finding of extraversion in sportsmen, reported by Cattell, is echoed in many other studies. In the manual of the Eysenck Personality Questionnaire (Eysenck and Eysenck, 1975), data are presented for 152 physical education students, along with 46 other occupational groups. Apart from a small group of men in the services, and salesmen, the physical education students have the highest mean score for extraversion. Compared with other groups of their age they are around average for neuroticism, and only very slightly below average with respect to psychoticism. (It is necessary to compare groups with standardisation data or control groups of similar age; extraversion, neuroticism, and psychoticism all decrease with age from a high at late puberty. Many published data do not correct for age, and hence their conclusions are suspect. In these cases, wherever possible, we have reinterpreted the results reported, taking age into account). The differences between the results of this study and Cattell's (1970) may be due to the fact that Cattell was dealing with outstandingly successful sportsmen, whereas the EPQ study dealt with average performers;

Table 3. The primary and secondary source traits covered by the 16PF test

Factor	Low Sten Score Description (1-3)	High Sten Score Description (8-10)
A	Reserved, detached, critical, aloof, stiff Sizothymia	Outgoing, warmhearted, easygoing, participating Affectothymia
B	Dull Low intelligence (Crystallized, power measure)	Bright High intelligence (Crystallized, power measure)
C	Affected by feelings, emotionally less stable, easily upset, changeable Lower ego strength	Emotionally stable, mature, faces reality, calm Higher ego strength
E	Humble, mild, easily led, docile, accommodating Submissiveness	Assertive, aggressive, competitive, stubborn Dominance
F	Sober, taciturn, serious Desurgency	Happy-go-lucky, gay, enthusiastic Surgency
G	Expedient, disregards rules Weaker superego strength	Conscientious, persistent, moralistic, staid Stronger superego strength
H	Shy, timid, threat-sensitive Threctia	Venturesome, uninhibited, socially bold Parmia
I	Tough-minded, self-reliant, realistic Harria	Tender-minded, sensitive, clinging, overprotected Premsia
L	Trusting, accepting conditions Alaxia	Suspicious, hard to fool Protension
M	Practical, "down to earth" concerns Prazernia	Imaginative, bohemian, absent-minded Autia
N	Forthright, unpretentious, genuine but socially clumsy Artlessness	Astute, polished, socially aware Shrewdness
O	Self-assured, placid, secure, complacent, serene Untroubled adequacy	Apprehensive, self-reproaching, insecure, worrying, troubled Guilt proneness
Q1	Conservative, respecting traditional ideas Conservatism of temperament	Experimenting, liberal, free-thinking Radicalism
Q2	Group dependent, a "joiner" and sound follower Group adherence	Self-sufficient, resourceful, prefers own decisions Self-sufficiency
Q3	Undisciplined self-conflict, lax, follows own urges, careless of social rules Low self-sentiment integration	Controlled, exacting will power, socially precise, compulsive, following self-image High strength of self-sentiment
Q4	Relaxed, tranquil, torpid, unfrustrated, Low ergic tension	Tense, frustrated, driven, overwrought High ergic tension

if neuroticism interferes with achievement, then it seems reasonable to expect superstars to have lower neuroticism than average performers. Equally, if the qualities represented by P are favourable for great achievement, then P should be found more highly developed in superstars than in average performers.

In an unpublished study using the EPI (Eysenck, 1964), Nias assessed 118 first-year male students upon entry to a four-year degree course in physical education. They scored at the seventy first percentile for E, with a mean score of 14.53, which is outside the range of scores given in the manual. For N their score was just about average. The control group of 108 students starting a course in creative design scored higher on N and much lower on E. The same author tested 39 members of the British athletics team and found that they scored just about average for N, but at the fifty ninth percentile for E, i.e. clearly above the average.

These groups were also assessed with the 16PF and the Edwards Personal Preference Schedule (EPPS). On these scales the P.E. students and the international athletes obtained similar scores, which were very different to the norms in the manual, either for students or for the general population. For the 16PF, the P.E. students and the international athletes scored markedly higher on intelligence, assertiveness, happy-go-lucky disposition, expediency, forthrightness, and undisciplined self-conflict. For the EPPS, both groups were characterised by high scores for achievement, heterosexuality, and aggression; their lower scores were for deference and order. These scores suggest high extraversion and high P (low superego); there is not much evidence here of low neuroticism.

Much the same can be said of many other studies, such as those of Ikegami (1970), Sperling (1942), Conforto and Marcenaro (1979), Herbt (1970), and White (1952); here too extraversion (or traits falling under that general heading) are frequently mentioned, but the relevance of other personality dimensions is not clear. Cattell's report of stability in Olympic champions does not seem to be characteristic of sports groups in general; rather, the various groups are about average on this dimension. Again differences in level of achievement make comparisons difficult.

Warburton and Kane (1966) studied Olympic competitors and found above average extraversion, but unlike Cattell did not find a significant tendency towards stability. In fact, the only clear claim of below average anxiety comes from Ogilvie (1970), who reported on a select group of young high level swimmers. Brooke (1967) studied 118 physical education students, and obtained results consistent with those reported above from the work of Nias, in that the only major difference was in relation to the high level of extraversion of these students.

It has often been suggested that the evidence of a characteristic personality for sportsmen is not clear-cut. Indeed, several researchers have produced results in which they reported failure to find significant differences (e.g. Keough, 1959; Knapp, 1965; Singer, 1969). But the results are usually in the direction of higher extraversion for the sportsmen, even where the differences have not attained significance. For example, Barbara Knapp (1965) studied 46 tennis players of Wimbledon standard. Wide individual differences were apparent on both extraversion and neuroticism scales; three of the players had neuroticism scores above the mean of dysthymic psychiatric patients! Nevertheless, the mean scores for this group were in the direction of extraversion and stability when compared with norms for the general population. And it is of course possible that a larger sample would have yielded significant results.

Contrary to Cattell's and Ogilvie's report of low anxiety or neuroticism in sportsmen, various researchers have reported an above average level on this dimension (e.g. Booth, 1958; Dimsdale, 1968; Johnson *et al.*, 1954; La Place, 1954; Stone, 1961). But an explanation for these contradictory results is sometimes at least partially apparent in terms of a decline in neuroticism with age. As already mentioned, it is essential to compare the sports group with a control group of a similar age. For example, in the case of Dimsdale's study, the Eysenck Personality Inventory was given to 33 athletes selected for a coaching weekend and their scores compared with those of the general population. The mean score for neuroticism was 11.25 compared with 9.06 for the general population. But this difference can be at least partly explained in terms of the mean age of the athletes at 21.6 years being less than that of the general population at about 30 years. Similarly, in the case of Stone's study, the Maudsley Personality Inventory was given to 50 athletes of at least county standard. Their mean score of 21.4 was significantly higher than the 19.9 mean of the general population. Again, this difference would all but disappear if allowance were to be made for the difference in age between the two groups.

The problems involved in working with the sub-factors of extraversion and neuroticism are well illustrated in a study by Simono *et al.* (1979). They assessed 63 firemen for fitness using a treadmill. The 16PF was also administered in the hope of finding personality correlates of fitness. Factor M was found to be the only scale significantly related to the fitness measure. According to the manual, a high score on this scale is interpreted to mean a tendency towards being "imaginative" rather than "practical". But matters are not this straightforward. A content analysis of the items making up the scale do not give us a clear

impression of any such variable. And Cattell's own work throws further doubt on the meaning of this particular scale. In one study, Cattell and Coan (1957) asked teachers to rate their school children for personality using the 16PF items. Those rated as high on factor M were independently described as "alert, wide-awake and energetic". In the light of the Simono *et al.* results, this seems a more convincing interpretation of the scale's meaning. Nevertheless, since factor M does not feature too prominently in the profiles of sports groups undue attention need not be given to this point. But it does illustrate the difficulties involved when working at the sub-factor level rather than at the level of the more reliable and better understood major factors.

The only exception to this generalisation may concern studies involving the Edwards Personal Preference Schedule. The work of Nias already mentioned has indicated that athletes score above average on need for achievement, heterosexuality and aggression, and below average on deference and order. Similar results have been obtained by Balazs and Nickerson (1976) with 24 female athletes in the U.S. Olympic team. Their highest scores were for achievement and autonomy, followed by aggression, succorance and heterosexuality. Achievement and autonomy were also found to be the highest scores among women athletes in a study by Neal (1963). Consistent results have also been obtained in other studies using the Edwards scale (e.g. Fletcher and Dowell, 1971).

An interesting study by Hendry (1975) involved 230 University students whose "amounts of movement behaviour" were compared with their scores on measures of personality. "Active students were, on average, more stable and extraverted, and had more favourable attitudes to physical activity. Active involvement in movement behaviour was positively related to previous school involvement, social class and extraversion for men; year of study, multiple choice scores and previous school involvement for women." (p. 19.) Competitive students, as compared with merely recreative participants in sport, were much more extraverted and much less neurotic, and these in turn more extraverted and less neurotic than non-participants. Scores on E for the three groups (males first) are: 13.8, 13.1; 12.4, 11.7; 10.0, 10.2. On N the scores are: 8.5, 9.9; 9.1, 11.4; 10.3, 12.4. women as usual are somewhat less extraverted and higher on neuroticism than males.

An interesting study by Hehl *et al.* (1981) compared 45 handgliders with 49 racing cyclists (both groups of high standing in their respective sports) with norms on various scales of a personality inventory published by Hehl under the title of "Persönlichkeits-Skalen System 25 (PSS 25)." Both groups showed significantly less anxiety than did the normative groups, were significantly less attached to their families, and more extraverted in various directions (sexual behaviour, professional mobility, etc.) The authors made specific predictions on 10 of the 25 scales used, and used the other 15 scales to establish a reasonable level of non-significance of intergroup comparisons.

Also of particular interest from a design point of view is a study of personality factor profiles of collegiate football teams (Kroll and Petersen, 1965). Using five teams ($n = 139$) and the Cattell 16PF scale, significant discrimination between teams was demonstrated with highest contributors to the derived discriminant function being factor B (intelligence), factor H (shy versus bold), factor O (confident versus worrying) and factor Q₃ (casual versus controlled). Based upon actual versus predicted group membership, the percentage of correct classifications was 55. When based upon prediction into winning or losing categories, the percentage of correct classifications was 82. The authors comment on the relative insignificance of univariate results, and the considerable increase in predictability when multivariate results, i.e. personality profiles, are used. This is another argument to contradict Sack's negative evaluation of the evidence as far as personality factors in sport are concerned; most investigators reporting negative results have used univariate analyses, rather than profile scores.

Ideally, some kind of multivariate analysis should be applied not only to the personality side of the equation, but also to the sports side. An attempt to do this has been made by Howard (1976) who carried out a factor analysis of the intercorrelations between various leisure activities, collecting data from 139 high-school students, who were also given the Personality Research Form, a questionnaire based on Murray's need-press theory; this inventory provides scores which measure 14 personality needs relevant to a wide variety of

human functioning. Factor analysis of the various leisure activities produced four factors: ON, referring to the outdoor nature of the activities (hiking, camping out over-night, boating, canoeing, fishing, hunting, etc.); S, for action-oriented seasonal competitive activities or "sports" in general (football, basketball, softball, tennis, etc.); AS, for aesthetic-sophisticate, with high loadings for playing tennis, and more moderate loadings for playing musical instruments and participating in painting, crafts, bicycling, and reading for pleasure; and finally LD, for "leisure detachment" (interpreted in the light of the fact that almost all of the high activity loadings were found to be negative.)

Factor scores were correlated with personality variables, and it was found that ON correlated significantly with autonomy, dominance, endurance, understanding, and negatively with harm avoidance. S correlated positively with aggression, autonomy, dominance, impulsivity, play, and negatively with harm avoidance, nurturance, order, and understanding. AS correlated significantly with affiliation, dominance, exhibition, and LD negatively with achievement, exhibition, and understanding. Disregarding the fourth factor, which is probably an artefact, we are left with correlations which on the whole agree with work previously reported, and with commonsense. Finally, Howard carried out a canonical analysis of the two sets of scores (PRF and leisure activity questionnaire), and found statistically significant correlations, the first amounting to 0.931. "The number of significant canonical correlation coefficients may be regarded as indicating that there are four independent ways in which leisure activity differences are related to personality. This means that there are at least four distinct dimensions which personality and leisure activity share. Each of the composite variables represented by these dimensions has a correlation significantly greater than 0, with at least one personality variable and one leisure activity variable." Howard made no attempt to interpret the canonical correlations, but presumably their substantive import is indicated by the correlations between the leisure activity factors and personality variables.

It must be said, however, that while multivariate analyses can be informative, they do suffer from the obvious fact that such analyses capitalise on chance errors, and when the number of variables is large, and the number of subjects small, as is usually the case, these errors are accumulative and become quite large. Most of the authors are aware of the fact that any findings should be cross-checked against another sample, but none of them appear to have adopted this way of demonstrating the validity of their findings. This being so, we should be careful in drawing conclusions from multivariate studies, and only accept profile analyses once these have been cross-checked on other samples. Admittedly such work would need much larger numbers of subjects, but the logic of the approach indicates that nothing less will do. It seems a pity that so many authors have offered sophisticated statistical analyses of complex designs which fail in this important respect. Sophisticated statistical analysis cannot make up for dearth of empirical data.

We end this section by quoting personality traits of sports champions of all kinds noted by their biographers, and assembled by Gauquelin (1973). The traits most characteristic of sportsmen were: "hardened, tenacious, sporty, courageous, reckless, unpretentious, enterprising, energetic". The least characteristic traits were: "eloquent, witty, dreamy, pompous, snobbish, shrewd, nonchalant, theatrical, and verbose". There is some slight evidence here of both extraversion and stability, but again not too much should be read into the amateur psychologising of professional writers.

5. DIFFERENCES BETWEEN SPORTS

Many attempts have been made to contrast the personality of participants in different sports (e.g. Booth, 1958; Butt, 1976; Dowd and Innes, 1981; Kane, 1966; Kroll *et al.*, 1978; Ogilvie, 1970; Peterson *et al.*, 1970). Thus Kroll *et al.* administered the 16PF to 358 nationally ranked Czech sportsmen. A multiple discriminant function analysis revealed a slight, but significant, difference in personality among the sportsmen in the different fields. Unfortunately, the researchers do not go on to describe the differences found; they rest content with the statistical significance of the obtained differences! This, one may perhaps

complain, is an unduly frustrating and restrictive way of reporting data; it would have been extremely interesting to see in what way sportsmen in different disciplines are differentiated from each other, having established that there *are* such differences.

Differences in personality are also apparent within sports. In a sample of athletes, for instance, Kane (1966) found sprinters and throwers to be more extraverted than middle-distance runners. As distance increases, extraversion seems to decrease, since two studies on marathon runners using the Myers Briggs Type Indicator reveal them to be introvert rather than extravert (Clitsome and Kostrubala, 1977; Gontang *et al.*, 1977). Moreover, there was also a tendency for the better runners to be more introverted than the less good.

Table 4 shows the different mean scores of members of different sports, using members of Olympic teams in the study already described in relation to Table 2. These figures can only be suggestive at this stage, as the numbers are quite small in most groups. The lowest P scores are observed in the equestrian events, which is not unexpected; there is minimal aggression and direct competitiveness in that sport. On the other hand, bobsleigh racing has the highest P score; even though there is no personal contact involved it is a very competitive and dangerous sport. The bobsleigh teams are also the most extraverted, with cyclists and fencers the most introverted. Cyclists are also highest on N, with fencers and bobsleigh crews the lowest. Equestrians have the highest L scores, fencers the lowest. It is difficult to make much psychological sense out of these data; quite possibly they are just aggregates of chance differences. Only future research and replication will tell us whether there is anything to explain here.

Most of the differences in the studies designed to detect differences between sports can be interpreted in terms of team versus individual participation. For example, Booth (1958) found extraversion to be more common in team than in individual sportsmen. Similarly, Peterson *et al.* (1970) found that Cattell's factor Q2, which is a subfactor of introversion, interpreted as selfsufficiency, was more apparent in individual than in team sports. These findings are not unexpected, and while the evidence is not as strong as one might wish, it does seem to go very much in the expected direction.

A much neglected area of study concerns the comparison of successful with less successful sportsmen. In comparing an elite sports group with the general population, it is usually implied that the differences obtained are characteristic of success. But a necessary control would be to have a third group consisting of sportsmen who are not outstanding. Only if differences are apparent between this group and the elite group can we conclude that personality is associated with *success* at sport, rather than simply with participating in sport.

Traits frequently encountered in the personality profiles of high level competitors, as compared with lower level competitors are self-control, conscientiousness and intelligence. This emerges from the work of Peterson *et al.* (1970) with members of the U.S. Olympic teams, Ogilvie (1970) with a group of elite swimmers, high level performers at baseball (La Place, 1954), with wrestlers (Kroll, 1967) and hockey players (Bird, 1970) and in the work of Johnson *et al.* (1954). Results unfortunately are not always easy to interpret, because some studies do not clearly report what criteria were used to identify high level sports ability, and in some studies, comparisons between levels of competence were made within a group of players of fairly homogeneous capacity (e.g. Singer, 1969; Keough, 1959; and Thune, 1949).

Nias, in his own (unpublished) work found that athletes of different levels are very similar

Table 4. The primary and secondary source traits covered by the 16PF test

	n	P	E	N	L
Cycling	12	4.6	12.7	9.2	5.8
Hockey	22	3.7	15.2	7.2	6.2
Fencing	10	3.0	12.9	5.9	5.0
Bobsleigh	16	5.3	18.1	5.9	5.3
Yachting	38	4.7	13.9	8.3	6.3
Athletics	20	3.6	14.6	8.0	6.9
Boxing	24	3.2	14.0	6.9	6.7
Equestrian	9	2.6	13.8	7.1	10.4

in personality; this point has already been noted above. This suggests that any sports personality may be associated with interest rather than with success in sport. Foster (1977) also found no consistent differences for 483 high-school children competing in various sports, when rated by their coaches as outstanding or unsuccessful. In this study it might be objected that the level of the "outstanding" player was still well below that of the international, and that hence the range of achievement was not sufficient.

More successful was the work of Bushan and Agarwal (1978). They gave the 16PF scales to 10 internationals in table-tennis and badminton and compared their scores with those of 10 low achievers. The internationals appeared to be more extraverted, being significantly more dominant (E) and surgent (F). Using a similar approach, Dowd and Innes (1981) studied 93 volley ball and squash players. Comparing the 16PF scores of those ranked in the top 15 in South Australia with the remainder who were regular participants, but of low standard, the better players were more intelligent (B) and less anxious (Q2). They also tended to be more experimenting (Q1), conscientious (G) and less controlled (Q3). These results suggest that excellence in sport is related both to extraversion and stability. More studies of this type are needed before we can say to what extent personality is associated with success, rather than with interest, in sport. Some of the comments by Dowd and Innes about their results are of interest. As they point out, "no causal account can be given from this study as to why the higher level participant should be less anxious and somewhat more extraverted. They may perform better because they are dispositionally less anxious, but they may also be less anxious situationally because they win more often and have achieved some status. What does emerge is that by establishing criteria for distinguishing between sporting groups, criteria established by the organising committees of the sports concerned, differences in personality can be revealed. This study has avoided the criticism that the overall differences between the groups were small either because the whole sample was of an elite nature or because the whole sample was at an average level. The difference in quality of performance between groups could be further enlarged, by for example examining the personality profile of National as well as State teams."

The authors go on to say that "in analysis of the total sample, personality factors did not play a large role in discriminating between volley ball and squash players. Volley ball players tended to be more forthright (factor N), more natural and spontaneous in their relationships with others. They were also less anxious. While greater spontaneity and less anxiety may be expected to facilitate performance in a setting requiring cooperation and coordination, the picture which emerges from an analysis of the high level players reveals a more complex picture. While forthrightness and lower anxiety remain, there is a contribution to the discrimination from intelligence (although State level players tended on the whole to be more intelligent than average players) and assertiveness. The volley ball player is more intelligent and more assertive and independent-minded than the State level squash player. This characteristic is not one which was expected on the basis of past research in this area (Peterson *et al.*, 1970), or on the basis of intuitive ideas about how individuals will be able to "get on" with others in a group. The differences in intelligence, assertiveness and forthrightness are quite marked, however. It might be hypothesised that assertiveness is a trait especially required by a team player in order to draw the attention of selectors to his performance at least during the early stages of a career. Assertiveness need not interfere with his team performance, provided several and not all of the players possess the same trait. Indeed, his heterogeneity of personality within a group has been shown on some tasks to be associated with better performance by that group (Hoffman, 1959). The relationship between group performance and group composition is likely to be a complex one. For example, the relationship between team performance and cohesiveness has been shown to be a highly variable one (Gill, 1977) and no doubt mediated by numerous factors including the nature of the team sport. The present data suggests that volleyball players may be able to combine their talents without necessarily subordinating their motives to others." (p. 11.)

This extensive quotation is included to indicate the kind of argument and interpretation that is needed in order to gain some form of psychological understanding of the raw data presented. Clearly much of it is subjective and speculative, but fairly clear-cut experiments are suggested for the future, and no one would of course consider the results so far reported

as definitive. However, from a commonsense point of view the suggestions made are sensible, and may be supported by future work oriented along the lines of the hypotheses suggested.

Reference has already been made to the study by Hehl *et al.* (1981), comparing handgliders and cyclists with a control group. These authors also provided some hypotheses comparing the handgliders with the cyclists. Basing themselves on Zuckerman's hypothesis of "sensation-seeking", and relating some scales on their own personality inventory to the four scales on the Zuckerman test, they predicted that, as compared with the cyclists, handgliders would be more depressive, self-indulgent, sexually promiscuous, free of anxiety, and lacking in hypochondria, mobile professionally, with little in the way of family ties and personally neglectful. The most clear-cut result related to their first hypothesis, showing the handgliders to be much more depressed than the control group, and the cyclists to be much less depressed than the control group, with the difference between the two types of sportsmen reaching a very high level of significance. Also verified at an acceptable level of statistical significance was the greater sexual promiscuity of the handgliders, and their lack of hypochondria. They were also very significantly more neglectful of their body and their clothing than were the cyclists, and had significantly fewer family ties. The other comparisons went in the predicted direction, but were not statistically significant.

This is a particularly interesting study because it tested explicit hypotheses, provided the unusual statistical control of using 15 scales for which no predictions were made as a sample of irrelevant personality dimensions, and provided a normal control group against which to evaluate the results. There seems to be no doubt that these two groups of sportsmen are very unlike each other in many ways, although, as we have seen, when they are compared with the norm, they also show the expected similarities.

The literature on differences between sportsmen and women entering different types of activities is unfortunately not as large as it ought to be, nor are the studies always well-controlled. Enough has been said to indicate that quite large differences do appear, and it is expected that further work along these lines will be most fruitful. Those undertaking such research should be warned, however, that, as indicated in Section 8, it may not be sufficient to compare one sport with another, but it may be necessary to go into quite specific detail within a given sport in order to bring out differences. Thus, as already mentioned, not all footballers may share the same type of personality; goal keepers may differ significantly from strikers, or fullbacks from midfield men. This point is taken up later on, but is mentioned here to indicate that the observed differences mentioned in this section may be minimal, and might be much larger had such finer distinctions within sports been observed.

6. PERSONALITY — STATES VERSUS TRAITS

Cattell and Spielberger are often credited with emphasising the distinction between *traits*, i.e. lasting dispositions towards certain types of behaviour, and *states*, i.e. momentary moods or reactions to specific situations. This distinction is important, but it should be realized that it has a respectable antiquity; over two thousand years ago Cicero, in his *Tusculanarum Disputationum*, explicitly put forward this same distinction:

(Now to come to the analogy of health and to make use at last of this comparison (but more sparingly than is the way of the Stoics), as some men are more prone to some diseases and other men to others, and so we say of certain people that they are liable to catch cold, certain others to attacks of colic, not because they are suffering at the moment but because they frequently do so; in the same way some men are prone to fear, others to another disorder, in consequence of which in some cases we speak of an *anxious temper* and hence of anxious people, in other cases of *irascibility* which is different from *anger*, and it is one thing to be irascible, another thing to be angry, just as an *anxious temper* is different from *feeling anxiety*; for not all men who are at times anxious are of an anxious temper, nor are those who have an anxious temper always feeling anxious, just as for instance there is a difference between intoxication and habitual drunkenness, and it is one thing to be a gallant and another thing to be in love. Moreover this proneness of some men to one disease and others to another is of wide application; for it applies to all disorders.)

Quite apart from personality traits, therefore, sportsmen may be characterised by states or feeling of energy, anxiety, anger, etc. In his study of genius, Sir Francis Galton (1869) concluded that “an abundance of energy” is the most common characteristic of men of genius. It seems that a similar conclusion is warranted in the case of world-class sportsmen. Morgan (1980) administered the Profile of Mood States rating scale to 16 wrestlers competing for a place in the 1976 U.S. Olympic team. This scale yields scores on six states in which 50 is the average score on each for the general population. Figure 4 shows that those wrestlers who did not make the Olympic team display a profile close to this average score of 50. In contrast, those selected for the team exhibit a high score for vigour, and low scores for tension, depression, anger, fatigue and confusion. This is described as the “iceberg” profile and seems to apply equally to other groups of highly successful sportsmen.

Figure 5 presents Morgan’s results for a group of 24 international runners, 9 Olympic wrestlers from the 1972 team, and 16 international rowers. The consistency of these results is remarkable and suggests that investigating states rather than traits may at least be equally useful in attempting to understand the determinants of success in sport.

Mahoney and Avenier (1977) adopted a similar approach in attempting to find the psychological characteristics of successful gymnasts. Twelve gymnasts who were competing for a place in the U.S. Olympic team completed a specially designed 53 item questionnaire. The gymnasts were subsequently ranked in order of their performance in the final trials and this rank order was correlated with their responses to the questionnaire. The highest correlations were for “self-confidence” (0.57), “frequency of gymnastic dreams” (0.45),

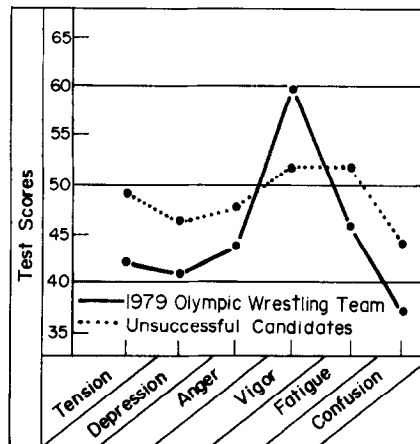


FIG. 4. Profile of Mood States Rating Scale comparing successful and unsuccessful candidates for the 1976 Olympic wrestling team. (Morgan, 1980.)

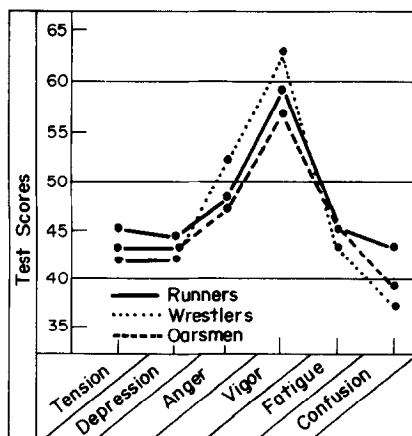


FIG. 5. Profile of Mood States rating Scale for runners, wrestlers and oarsmen. (Morgan, 1980.)

“degree of success in dreams” (0.55), “frequency of gymnastic thoughts” (0.78), and “frequency of self-talk in training and competition” (0.62). Relatively low correlations were obtained for “hours of training per week” (0.27), “perceived nearness to own potential” (0.15), and “ability to concentrate” (0.00). Although the sample size is very small, these correlations — as well as throwing light on the mental state of highly successful gymnasts — suggest that it might be possible to predict success in important competitions on the basis of psychological questionnaires.

The gymnasts were also asked about their anxiety level at various times. The best gymnasts revealed a picture of low anxiety one week before a competition (−0.35), high anxiety one hour before a competition (0.49), and then low anxiety while performing their best event (−0.42). This result illustrates how difficult it would be to assess anxiety as a trait in gymnasts. Feelings of anxiety are partly a function of the situation, and it appears that successful gymnasts are better able to control this anxiety when it is inappropriate or maladaptive. It is probably this ability rather than any absolute level of anxiety that is a characteristic feature of successful performers. In a replication of this study with racquet ball players, Meyers *et al.* (1979) obtained fairly similar results but unfortunately the sample size was only eight.

In our opinion, the most thorough investigation of state and trait anxiety in sport is the study of Schwenkmezger (1980), who gives a good review of the literature, and in his own studies illustrates the complexity of the issues. He reports three independent studies conducted to examine some hypotheses derived from the state-trait theory of Spielberger (1972).

The results of the first study, using 165 students of physical education in volley ball, brought out a significant relation between state anxiety and performance, but only in players where a high correspondence was present between expected and real performance. Thus *level of aspiration* plays an important role in mediating the effects of state anxiety, and level of aspiration has been found to be closely related to extraversion-introversion (Eysenck, 1947).

In a second study the author was concerned with the examination of the effects of the expected performance and the level of trait anxiety on the intensity of state anxiety, at two levels of situational stress. Subjects were 96 students of physical education, and the sport chosen was again volley ball. Significant differences in the intensity of state anxiety were found for three independent variables (trait anxiety, expected performance, and level of situational stress); there were, however, *no interaction effects* as would have been predicted from Spielberger’s theory. (Sex differences were also observed.)

In the third study two components of state anxiety, namely the emotional and the cognitive, were considered. The emotional component was operationally defined as the score on the state anxiety inventory, and the cognitive component as the intensity of the task-irrelevant cognitions during the test. Thirty-five subjects, members of the national handball team, were tested under two different levels of stress. Results for the emotional component again disconfirmed Spielberger’s theory, as in the second study mentioned above; however, for the cognitive component, the results support Spielberger’s theory, in that in situations with a low level of ego stress, differences in the intensity of state anxiety due to differences in the level of trait anxiety were not significant, while they were significant in situations with a high level of ego threat. These results are in agreement with Spence’s theory of anxiety-producing, distractive drive stimuli (Spence and Spence, 1966) and illustrate the complexity of the issues involved in using the concepts of trait and state anxiety in relation to sport. They also indicate that psychologically meaningful results can be obtained in properly designed experiments testing laboratory-derived theories.

Attitudes have also been assessed in sportsmen; these are less stable than traits, but perhaps more so than states, depending like the latter, however, on *situation*. Reid and Hay (1979) having found that soccer and rugby members of the Scottish National Universities squad did not differ significantly in personality, analysed their scores on an “attitudes to sport” scale. Their group of 36 rugby players obtained a higher score than 36 soccer players on the use of extra-legal aggression. Being prepared to use illegal aggression in competition was unrelated to personality within the rugby group; it appeared to be almost universally approved! For the soccer group, the use of extra-legal aggression was significantly related to extraversion; it seems that it is only the more extraverted of soccer players who approve of

such tactics. This supports the research reported earlier on sensation seeking and the use of dubious tactics.

It would of course be a mistake to make too sharp a distinction between traits and states; a person with high N is more likely, in any given situation, to experience a state of anxiety. Correlations reported in the literature between traits and states are often in excess of 0.5, which, when corrected for attenuation, suggests that about half of the variance of the state measures can be predicted from trait measures. Nevertheless, the additional information given by state measures can be most useful; a given person of high N is not equally anxious about all types of situations, and to know his particular proclivities may be very important. Smith and Jones may have equal N scores, but Smith, having also a very high IQ, may not be anxious about examinations, as is Jones, who is rather dull; Jones, on the other hand, having a strong body and being an excellent sportsman, may be less anxious than Smith when involved in a physical contest. It is unfortunate that so little work has been reported in this field; ideally both trait and state measures should of course be used in order to maximise information and predictive accuracy, and equally to gain more insight into the total situation.

Morgan (1980) has addressed this issue by stating: "Various personality traits have consistently been observed to account for 20%–45% of the variance in sport performance. In other words, to argue that trait theory should be abandoned (skeptical view) is no more appropriate than arguing that trait theory is a precise predictor of behavior in sports settings (credulous view)." (p. 72.) He goes on to say that: "Any dependent variable that accounts for 20%–45% of the variance should theoretically be useful in predicting behaviour if utilized in concert with other dependent measures". (p. 72.)

Somewhere intermediate between states and traits might be thought to lie more specific attitudes, such as those measured by Kenyon's (1968a,b) test, which contains six subscales. These relate to the social experience of sport, the health giving properties of sport, sensation seeking aspects of sport, the aesthetic experience of sporting activity, and cathartic properties of sport. The major application of Kenyon's work has been by Sack (1975), who used a translated and more highly developed German form of the test; this test has alternative forms for males and females.

Sack also used what he calls the Eigenschaftswörterliste (EWL); this consists of 25 bipolar items relating to personality traits which make up six dimensions of personality (communication, tenacity, constitution, emotional stability, endeavour, extraversion). The EWL is presented to subjects with four different instructions. These are: (a) self-concept (as I see myself); (b) the ideal self (as I would like to be); (c) stereotype (as I see the typical male middle and long-distance runner); and (d) stereotype (how I see the typical female middle and long-distance runner).

Sack argues, as already mentioned before, that general personality traits will show the least differentiation between the three groups he studied, i.e. Wettkämpfer (competitive runners), Nichtwettkämpfer (non-competitive runners), and Nichtsporttreibende (subjects not taking part in organised sports), whereas the EWL would show more differences, and the Kenyon type of test most.

Figure 6 shows the main outcome of his results in graphic form. The ordinate shows the percentage of correct identification of the groups, with the bottom line giving the mean percentage values for males and females; the abscissa shows the three sets of data, i.e. the personality inventory (FPI), the EWL, and the Kenyon test. Sack gives similar diagrams showing the ability of the different types of test to discriminate between different classes of runners, and between runners as opposed to ball players, as already mentioned in a previous section. For the differences between the three classes of runners (national team, regional team, and sub-regional local team) the relative contribution of FPI, EWL, and Kenyon test are similar to those shown in Fig. 6, although for all three the contribution to this discrimination is less than that between sportsmen and women and non-sportsmen and women shown in Fig. 6.

It is not too clear just how the EWL and the Kenyon test should be classified. Some aspects of the EWL are clearly similar to ordinary personality questionnaires of the trait type, while others resemble more the state conception, and are probably more variable over time. The

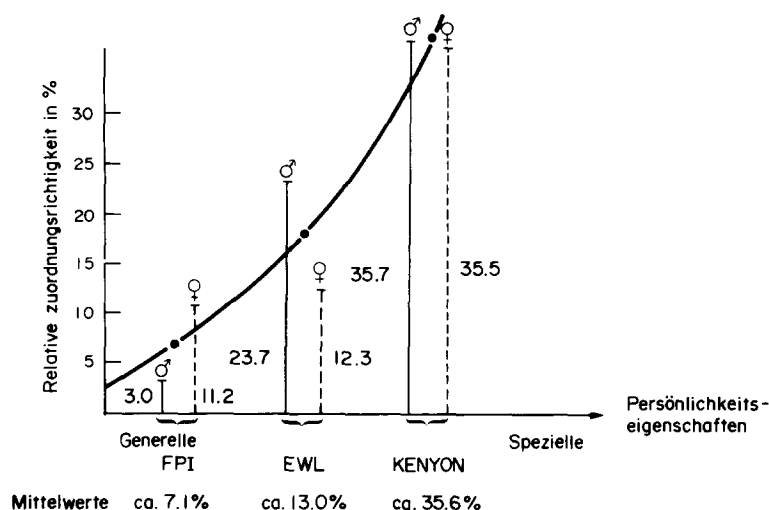


FIG. 6. Diagram showing the increase in accuracy of prediction of three groups (competitive runners, non-competitive runners, and non-sportsmen and women) on a personality test (FPI), a bipolar trait attribution scale (EWL) and the Kenyon Attitude to Sports Scale. (From Sack, 1975.)

fact that the EWL explicitly contains scales for extraversion and neuroticism (emotional stability) suggests that the superiority of this test over the FPI may be due to this explicit inclusion. It certainly cannot be agreed that there is any difference in principle between FPI and EWL as far as the measurement of general personality traits is concerned. It will also be noted that the differences between the two only apply to the males, for the females results are almost identical. This makes one doubt very much whether the results can really be taken to support Sack's hypothesis that the more general the personality measures used, the less is the variance accounted for.

The Kenyon test, admittedly, contributes most, but this is hardly surprising as there is a good deal of confounding between the questions asked in the Kenyon Test, and the actual behaviour shown in participation in sport. One is grateful for the empirical data, but commonsense would have predicted precisely this outcome. Questions specifically relating to the area of study will inevitably be more predictive than questions not so related.

One further type of scale should be mentioned here which, while related to personality, hovers uncertainly between state and trait, and that is the study of values. Kroll and Petersen (1965b) complemented the study of six football teams already mentioned previously by administering the Allport and Vernon Study of Values to 276 members of collegiate football teams. The values included are theoretical, economic, aesthetic, social, political and religious, and the 6 teams which were studied included three winning and three losing matched on various variables. Discriminant analysis for the six groups showed one factor significant at the 0.01 level, and a second at the 0.05 level. Most of the observed differences seemed to be related to the status of the schools from which the teams came, which is of doubtful relevance to sport as such. University teams were low on theoretical and social variables, State colleges medium, and private schools high. On the other hand, universities were high on the economic variable, State colleges medium, and private schools low. Winning teams were found to score lower on the social factor than the losing teams, and this result may suggest that possibly winning sportsmen are higher on P than losing ones, although the relationship between values and personality has not been studied sufficiently to make this more than a possible suggestion. Few other investigators have used the Study of Values Test, and consequently little more can be said about it.

7. DRIVING AND SEXUAL ABILITY

It has already been pointed out in the introduction that the definition of sport is an uncertain one, and that there is considerable latitude as to what is to be included and

excluded. In this section we will be dealing with two areas which are at the borderline of what is usually regarded as sport, but which show interesting personality correlates very much in line with those found in other areas of sporting activity, suggesting that perhaps both driving and sexual behaviour may be regarded as sporting activities from some points of view. Certainly both are physical activities, often undertaken for the sake of pleasure or amusement, giving rise to competitive feelings, and often involving quantitative estimates (so many miles per hour; so little time to cover a given distance; so many "conquests"; the ability to maintain an erection for such a length of time; the ability to prolong intercourse for such a length of time; etc.).

Let us consider driving first of all. A useful index of excellence in this "sport" may be the avoidance of accidents; clearly an accident in driving is rather like an "own goal" in football; or a double-fault in tennis. Whatever else constitutes excellence in driving, an accident will count against it. Hence a concept of "accident proneness" (Shaw and Sichel, 1971) is a crucial one in the estimation of driving excellence. (We are in this section dealing entirely with amateur or professional driving in towns and in the countryside, in straightforward mass-produced cars, rather than with racing driving or rally driving.)

What would be the expectations from the general personality theory here developed? As far as extraversion is concerned, we would expect extraverts to be more accident prone for a variety of reasons. In the first place extraverts are more reckless and risk-taking, and it is likely that when risks are taken, sometimes the person taking risks comes to grief. In the second place, extraverts are sensation-seekers, and the sensations sought in driving is often incompatible with good driving, i.e. the driver will seek to drive very fast, drive in competition with others, and generally behave in a manner which is unsafe. In the third place, long continued driving requires vigilance, and the low arousal level of the extravert has been shown to lead to much lower levels of vigilance (Eysenck, 1967). It is also possible that the quick reflexes and the lack of inhibition of the extravert may make him a better driver, in the sense of being able to react better to external circumstances when driving at the same speed as the introvert, but of course the whole point of the comparison is that the extravert is likely to find himself in many more dangerous situations due to his search for higher speeds, greater excitement, and general lack of care. The demonstration that extraverts tend to trade accuracy for speed, while introverts prefer accuracy, as compared with speed (Eysenck, 1947) illustrates this feature of extraverts' behaviour vividly.

As regards neuroticism, the argument is similar to that already presented in relation to other types of sporting activity. Anxiety leads to the occurrence of drive stimuli which interfere with the primary task, act in a distracting manner, and produce errors and failures. The typical high N scorer would be expected to use only some of his attention capacity for the driving task, the rest to introspection of his autonomic arousal, and his cognitive emotional dysfunctions. We would thus predict that the person least likely to be a "safe" driver would be the high N high E person. There is much evidence that this is indeed so, and for a survey of the literature the reader is referred to Shaw and Sichel (1971), in their book on "Accident Proneness". Figure 7 shows the relationship between extraversion, emotional instability, and accidents in a group of South African bus drivers. The total circle has been divided into four parts by oblique lines, so that at the top right there is a space reserved for emotionally unstable extraverts, while at the bottom on the left an equal space has been reserved for the stable introverts. It will be seen that out of 10 drivers who are emotionally unstable extraverts, only one has a fair accident record, and none has a good accident record. Among the emotionally stable introverts, there is not a single driver with a poor or bad accident record. The remaining drivers are arranged in the central sections, and these too show a marked difference between the more extraverted and unstable, and the more introverted and stable. Statistical analysis showed the differentiation to be significant beyond the 0.01 level.

Shaw and Sichel quote results from a study by Quenault, who worked with two groups. Group C consisted of 50 drivers whose licenses had been endorsed within the last three years for careless driving; these drivers were found to have three times as many accidents as the other group, and each had had at least one accident — usually associated with a licence endorsement. Group R consisted of 50 drivers selected at random from the same geographical area and period of time with no convictions for careless driving, and most of

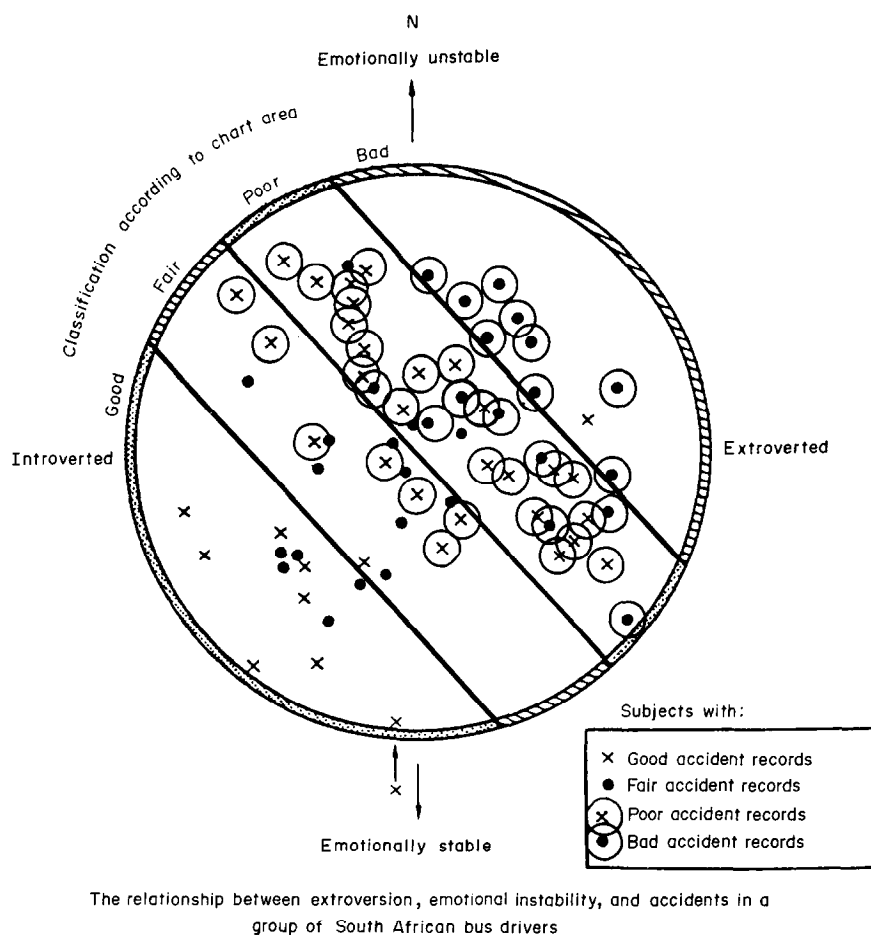


FIG. 7. The relationship between extraversion, emotional instability, and accidents in a group of South African bus drivers. (Shaw and Sichel, 1971.)

them with no recorded accidents. Figure 8 shows the results, again subdivided as before. Again the findings are significant at the 0.01% level, thus lending confirmation to the original work of Shaw and Sichel. It should be noted that they used personality measures to select bus drivers, and could demonstrate a very marked reduction in accident rate when only emotionally stable introverts were so chosen. When the company discontinued the selection process, the accident rate went up again, only to be reduced again when selection along these lines was introduced again. Other studies could be cited giving results similar to those quoted above, such as the work of Shoham *et al.* (1979), but comprehensiveness is not intended in this brief section.

Turning now to sex, we would suggest that along theoretical lines extraverts would be predicted to be more active than introverts, and high N scorers less so than low N scorers, with probably many psychosomatic difficulties. Eysenck (1976) made a number of specific predictions relating to extraversion, namely that: 1) Extraverts will have intercourse *earlier* than introverts. 2) Extraverts will have intercourse *more frequently* than introverts. 3) Extraverts will have intercourse with *more different partners*. 4) Extraverts will have intercourse in *more different positions* than introverts. 5) Extraverts will indulge in *more varied* sexual behaviour outside intercourse. 6) Extraverts will indulge in longer precoital loveplay than introverts.

These predictions have been tested by Eysenck (1976), Zuckerman *et al.* (1972), and Giese and Schmidt (1968). Table 5 shows results from the work of Giese and Schmidt on students; they divided their male and female subjects into three groups, ranging from introverts (E_1) through ambiverts (E_2) to extraverts (E_3). Table 6 shows correlations between sensation-seeking scales (sub factor of extraversion) and sexual behaviour. Other studies are reviewed

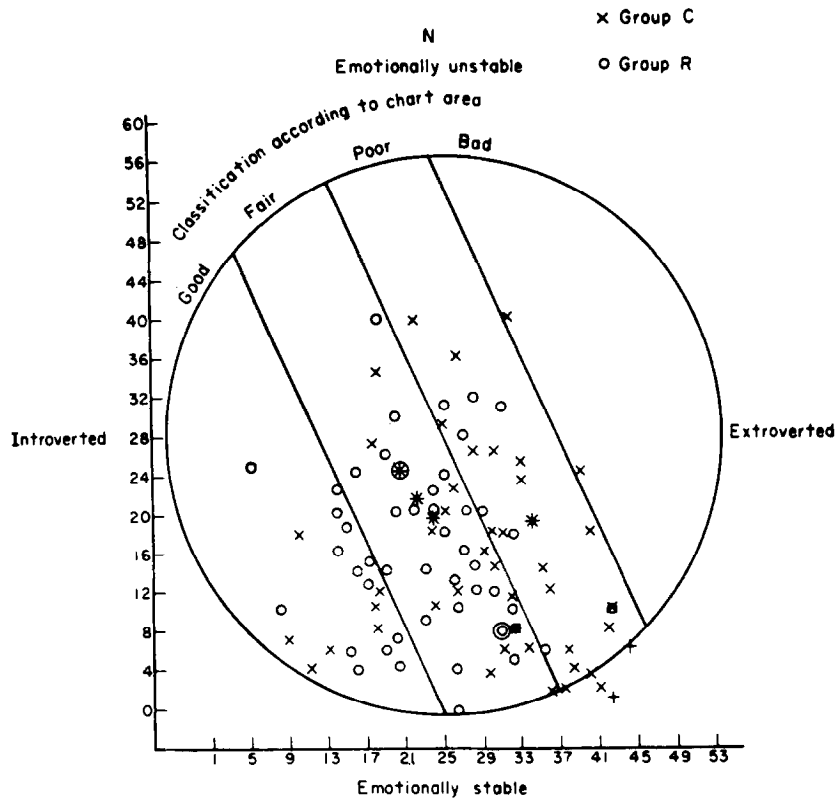


FIG. 8. The relationship between extraversion, emotional instability and traffic offences. Group R = safe drivers; Group C = careless drivers. Data from Quenault, diagram from Shaw and Sichel, 1971.

Table 5. Sexual activities of introverts (E_1), ambiverts (E_2) and extraverts (E_3) (figures taken from Giese and Schmidt 1968)

		Males			Females			
		E ₁	E ₂	E ₃	E ₁	E ₂	E ₃	
1.	Masturbation at present	86	80	72	47	43	39	
2.	Petting at 17	16	28	40	15	19	24	
	Petting at 19	31	48	56	30	44	47	
	Petting at present age	57	72	78	62	71	76	
3.	Coitus: at 17	5	13	21	4	4	8	
	Coitus: at 19	15	31	45	12	20	29	
	Coitus: at present age	47	70	77	42	57	71	
4.	Median frequency of coitus per month (sexually active students only)	3.0	3.7	5.5	3.1	4.5	7.5	
5.	Number of coitus partners in last 12 months; unmarried students only	1 2-3 4+	75 18 7	64 25 12	46 30 25	72 25 4	77 17 6	60 23 17
6.	Long precoital sex play	21	25	28	21	16	18	
7.	Cunnilingus	52	62	64	58	69	69	
8.	Fellatio	53	60	69	53	59	61	
9.	More than three different coital positions	10	16	26	12	18	13	
10.	Experience of orgasm nearly always	—	—	—	17	32	29	

Table 6. Correlations between sensation-seeking scales and sexual behaviour

	Heterosexual activities 1		Heterosexual activities 2		No. Heterosexual partners	
	M	F	M	F	M	F
General	0.51	0.15	0.39	0.29	0.40	0.27
Thrill and adventure-seeking	0.44	0.16	0.42	0.35	0.47	0.20
Experience-seeking	0.37	0.32	0.45	0.37	0.35	0.28
Disinhibition	0.33	0.43	0.39	0.33	0.42	0.29
Boredom susceptibility	0.36	0.29	0.23	0.20	0.25	0.20

by Eysenck (1976) and give similar results; there is no doubt about the greater heterosexual activity of extraverts along the lines predicted.

As far as neuroticism goes the predictions are also verified on the whole; high N scorers tend to suffer more than low N scorers from premature ejaculation, impotence, frigidity, and lack of orgasmic capacity; furthermore, they suffer more from guilt feelings and worries about sexual activity, and are strongly dissatisfied with their sexual behaviour. A survey of the available literature is given in Eysenck's "Sex and Personality" (1976), and we will therefore refrain from going into more detail here. Clearly there is a strong relationship between personality and sexual behaviour, very much along the lines predicted, and if we regard sexual behaviour in part at least as a "sport", then these results fall very much in line with the remainder of this review.

It is of course realised that for most people (particularly women) sexual activities mean a great deal more than simple physical amusement, and that particularly for religious people such a view would seem anathema. This is not the place to argue about ethical and moral problems of this kind; but it is clear from the studies of Eysenck (1976) that the majority of male subjects did regard sexual activity very much along the lines of recreation rather than procreation.

8. SPECIFICITY OF SPORT/PERSONALITY RELATIONS

The general point made at the beginning of this paper, namely that general personality type factors or "superfactors" are on the whole preferable for analysis to primary traits should not be extended too far, or taken as axiomatic. It is possible to predict quite specific relations between certain aspects of personality or behaviour, on the one hand, and specific successes or failure in sport, on the other. An illustration of how this can be done is furnished by the important work of Babarik (1968) on automobile accidents and driver reaction patterns. It is well known that in spite of theoretical expectation, reaction time measurement has never shown much (if any) relation to accident proneness. Babarik argued that some drivers are run into from behind because they react slowly to visual stimuli (initiate responses late), but that once the reaction is begun it is carried out exceptionally fast; he called this the desynchronizing reaction pattern (DRP). He submitted a number of taxi-cab drivers to a laboratory test in which he measured both the time to react to a stimulus, and also the speed of the resulting movement. Comparing the types of accident of these drivers with their reaction time patterns, he found strong relations between a pattern of driving behaviour consisting of many accidents of the "run into from behind" type, and DRP behaviour on the laboratory apparatus. Such specific relations can easily get lost in too general an approach to the problem of accident proneness, and the study suggests the importance of quite specific hypotheses relating to quite specific types of accident. Such studies complement, but they do not replace, the wider implications of personal determinants of accident proneness; they do suggest, however, that specificity theories may still have something to teach us if they are understood in the proper spirit, and not used on *a priori* grounds to suppress other types of research.

One might doubt whether the combination of slow reaction times and quick movement times constitutes a trait of "personality", but this criticism seems to be misplaced. Personality, as usually defined, relates to dispositional determinants of habitual activities; thus habitual behaviour patterns like that relating slow reaction times to quick movement times would be an aspect of behaviour which could be reasonably subsumed under the concept of "personality". It seems quite likely that this particular pattern would be found to be related to higher order factors, in the same manner that the trade-off between speed and accuracy has been found to be related to extraversion-introversion (Eysenck, 1947). However, even in the absence of evidence on this point, the fact remains that here we have a habitual reaction pattern which clearly determines to a remarkable extent driving behaviour.

Baton changing in relay races, passing the ball in football, and returning a fast service in tennis may be activities that could be usefully studied using this paradigm.

An interesting application of personality theory to quite specific behaviour within a given

sport is an unpublished paper by Coleman (1979). This is concerned with personality and stress in the shooting sports, and in it she related scores on the EPI to several types of shooting behaviour namely prone rifle shooting, 3-positional rifle shooting (prone, standing and kneeling); air-rifle shooting (standing position only); rapid fire pistol; free pistol; running boar; and clay pigeon shooting, both skeet and trap. Prone rifle shooters shoot in only one position, namely lying flat on the ground. The shooter has plenty of time to take his shot, and to take into consideration factors of wind, change in position, etc. Three-positional rifle shooters also shoot in the kneeling and standing positions, as well as in the lying position, these being progressively less stable, with more movement of the rifle requiring to be controlled. There is less time to contemplate the target and more emphasis on getting the shot away as soon as a good sight picture is obtained. Air rifle shooters have similar problems but shoot only in the standing position.

The free pistol event is a deliberate, precision event allowing the shooter quite a lot of time to concentrate on the accuracy of the shots. Again, the shooter is standing, there is even less support for the weapon and so there is a large degree of movement to be controlled. In the rapid fire pistol event, the shooter has a very limited time to fire five shots on five targets. The event is shot under several different time conditions: 4 seconds, 6 seconds, and 8 seconds. There is no time at all to consider changes of weather or position. The whole sequence is completely automatic.

The running boar shooters have to hit a moving target (shaped like a boar) which is exposed for only $2\frac{1}{2}$ seconds (fast runs) or 5 seconds (slow runs). There is a certain amount of time for adjustment of sight picture, etc. but again to a very large extent, the whole sequence has to become automatic and reflexive. The trap shooters are firing at a moving target whose trajectory is considerably less predictable than that of the previous group. The clays can follow any one of three possible trajectories. Shooters have to make instantaneous decisions and changes of tactics to adjust for this and score a hit in a very short period of time.

The trajectory of the clay and skeet shooting is much more predictable in still air. The shooter knows the speed and direction of the clay in advance, and although it is not recommended, in the absence of wind it is possible to aim at a point in the sky where the clay will pass. Hence, all the different shooting events make different demands of the shooter's mental reaction.

Results on the extraversion scale of the E.P.I. are shown in Table 7. The scores for the normal population are taken from the standardization data of the E.P.I. It will be seen that the degree of extraversion seems to increase in proportion to the number of factors to be controlled and the number of possible decisions to be taken. As Coleman puts it, "one might say it varies in proportion to the number of operations which have to be relegated to the unconscious" — or the cerebellum, as a physiologist might put it!

The prone rifle shooters with a fixed target and virtually no movement of the weapon are the most introverted. The air rifle, three-positional rifle and free pistol groups also have a fixed target, but more skill is required in moment to moment changes of position to control movement of the weapon. For the remaining three groups, the factor of time is more critical and also the time when the target appears is variable. The running boar shooters, who have

Table 7. Extraversion scores of different types of rifle and pistol shooters

	n	\bar{X}	Percentile	P
Normal Population		12.07	50.0	—
Prone Rifle	21	8.43	14.8	0.001
Air Rifle	11	11.00	40.5	NS
3P Rifle	15	10.10	32.0	NS
Air Rifle + 3P Rifle	26	10.50	35.9	NS
Free Pistol	19	9.74	29.2	0.01
Rapid Fire Pistol	15	15.60	78.5	0.01
Running Boar	5	12.20	51.0	NS
Clay Pigeon — Skeet	14	12.80	58.3	NS
Trap	13	10.60	35.4	NS
"Grass Roots" Prone Rifle	19	10.53	35.9	NS

to cope with a moving target as well, come out as ambiverts. The rapid fire pistol group has even less time to fire shots, and also has to cope very rapidly with changes in position to move the pistol from target to target. They emerge as very extraverted. With trap shooters, the clay appears as soon as the shooter calls, but can follow any one of three trajectories. Hence there is a need to hesitate before shooting in order to gauge direction. The extraversion score for this group is almost identical with the score of the three prone and air rifle groups. These three different events have quite a lot in common in that the latter two groups also have to delay shooting until a good sight picture is obtained. The skeet shooters know in advance the direction of the trajectory of the clay, but the time of its appearance can vary from 0–3 seconds. The skeet shooters have a similar extraversion score to the running boar shooters, that is, in the ambivert range. Again the two groups have many similarities in shooting procedure.

Scores on impulsiveness were also derived from the E.P.I., and it was found that degree of impulsiveness seemed to be linked to the number of factors requiring to be taken into consideration in firing a shot. Prone rifle shooters were significantly below the mean of the standardization group, as were free pistol shooters. Rapid fire pistol shooters were significantly above the standardization score, and running boar shooters had an equal score with rapid fire pistol shooters, but the difference from the normal population mean just failed to achieve significance because of the small numbers involved. Skeet shooters also had a higher score on impulsiveness, almost as high as the running boar and rapid fire pistol shooters. As Coleman explains “for these three groups where the events are ‘explosive’ in nature, it may be an advantage to be rather more impulsive”.

With respect to stress and anxiety, Hammock and Prince (1954) and Burton (1971) found that high anxiety impaired performance. Coleman (1979) compared 14 members of the British “A” Squad and 18 members of the British “B” Squad, the former having a higher level of performance. She used the Heimler Social Functioning Scale for this comparison. Basically, the questionnaire measures the satisfactions experienced in life (work, finance, friendship, primary and secondary family, and personal life), the areas of frustration (lack of activity, physical symptoms, influences from others, depression, escape routes) and the overall view of life (how good or bad life seems looking to both future and past) at the present time. The scale measuring satisfaction is a position scale, the scale measuring frustration is a negative scale, and the overall view of life is known as the synthesis.

Table 8 shows the outcome of the comparison. Clearly and significantly the “A” Squad have a higher mean positive and a lower mean negative score, and on synthesis are also superior. As Coleman says, “comparing the results from the two groups of shooters with the expected scores from ‘normals’, one can see that the ‘A’ Squad have an average score that is supernormal. They have far more satisfaction from life and far less frustration. The “B” Squad have on average a normal amount of satisfaction, but the frustration score is equal to one third of this. If the frustration score is more than one fifth to one third of the positive, the individual begins to cope less well. So that as a group, the ‘B’ Squad are less able to cope, as measured in these terms.”

Coleman also compared shooters promoted from “B” to “A”, shooters relegated from “A” to “B”, and shooters dropped from “B”. Defining “coping” shooters as those who go up to squad “A” or remain there, and “non-coping” shooters as those who go down to “B”

Table 8. Comparison of “A” and “B” squads on positive negative and synthesis scores on the Heimler scale of social functioning

N	“A” Squad	“B” Squad	
Mean Positive	X = 81.64 (69–97)	X = 72.5 (32–90)	p = 0.1
Mean Negative	X = 12.57 (0–29)	X = 24.94 (8–57)	p = 0.01
Synthesis	X = 82.14 (65–100)	X = 71.56 (49–89)	p = 0.001

or leave the squad, Coleman found the results given in Table 9. Clearly "coping" is related to success in shooting, as defined in terms of success.

An examination of the subscale scores revealed that success was related to lack of anxiety in areas of primary family (mother, father, and siblings), secondary family (wife and/or children), and personal life. A similar result was found by Gasele *et al.* (1974) in that high school boys who took part in athletics tended to have more harmonious relations with their parents and also a higher degree of popularity with their peers, than non-athletes.

On the negative subscales, the main differences existed in areas of depression and persecution, or influence from others, the less successful shooters expressing more negative feelings about their relationships in general and depression. They also made more frequent use of escape routes like drinking, drug taking, under- or over-eating, etc. Myers (1968) also found that individuals in successful teams had better interpersonal perceptions of their team mates than in unsuccessful ones.

The Coleman study has been described in some detail, not only because it is unpublished, but also because it illustrates that by concentrating not on overall groupings of extreme heterogeneity, but rather on quite specific groups within a quite specific sport, very significant results can be obtained even with relatively small numbers. The temptation has always been to issue personality questionnaires (often chosen more or less at random) to large groups of sportsmen (also often chosen at random or on the basis of convenience), and then to publish mean values which are frequently compared with standardization groups which are different in age, social status and many other ways to the sporting groups studied. This clearly is not the way to achieve scientifically valuable results, but almost guarantees that results will be difficult to replicate, and of little importance.

An interesting study relevant to this suggestion has been reported by Stejskal (1981), who studied the relationship between visual reaction time and neuro-muscular coordination in skiers. Reaction time to 50 visual stimuli was measured, using alternative responses to be made with the right or left hand. Responses were classified into normal, anticipatory, excessive, and irregular; these types being defined as follows. When all the response times

Table 9. Comparison of coping and non-coping shooters on the positive, negative and synthesis scales of the Heimler scale of social functioning

	"Coping" Shooters	"Non-coping" Shooters	P
Positive Scale	80.3	65.7	0.001
Negative Scale	16.15	31	0.001
Synthesis	81.3	66	0.001

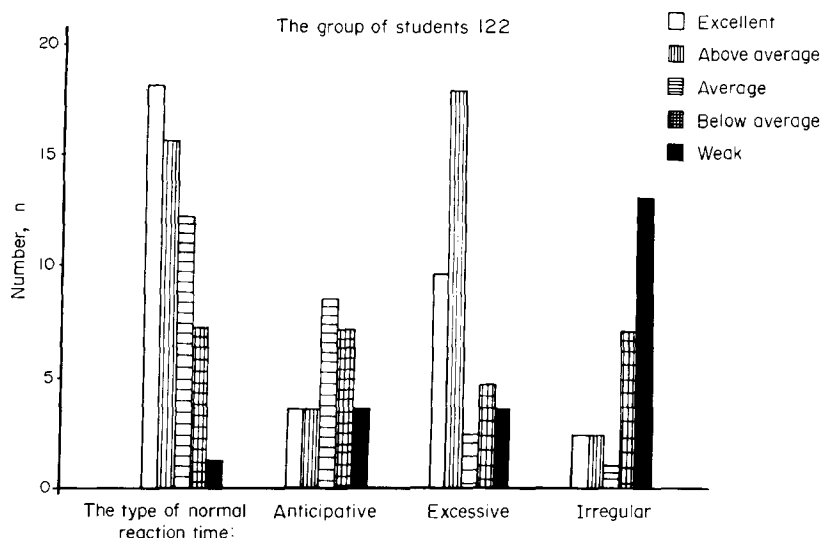


FIG. 9. Level of neuro-muscular coordination as shown in skiing, in four groups of students characterised by different types of reaction time performance. (From Stejskal, 1981.)

ranged within the time interval from 200 to 360 ms., the type of responses was regarded as normal. When more than eight responses were below the 200 ms. mark, the respondent's type of response was called anticipatory. When more than eight reaction times exceeded the limit of 360 ms. the style was labelled "excessive". Irregular types showed responses exceeding the limits in both directions more than four times.

Figure 9 shows the results, and it will be clear that there is a relationship between the neuro-muscular coordination shown by the 122 subjects in their skiing practice, and reaction time results. Normal reaction times had a very large number of excellent skiers, and very few weak ones, whereas irregular response times had a high number of weak skiers, and very few excellent ones. This study is not described in sufficient detail to make evaluation easy, but it seems to support the suggestion made for studying specificity of sport/personality relations.

9. EFFECTS OF EXERCISE AND COMPETITION ON PERSONALITY

The notion that physical exercise has beneficial effects, not only on physical health, but also on mental health, personality and mood is age-old. Plato pointed out that: "Avoid exercising either mind or body without the other, and thus preserve an equal and healthy balance between them. So anyone engaged in mathematics or any other strenuous intellectual pursuit should also exercise his body and take part in physical training. By such moderate motion he can reduce to order and system the qualities and constituents that wander through the body." (Timeaus and Cortias). In more modern terms, Harris (1973) has argued that: "The somatopsychic rationale for man's involvement in physical activity and sport, in brief, is the theory that bodily activity and function influences behaviour". (p. 240.)

In West Germany, several firms have set up special reconditioning clinics and introduced keep fit sessions during lunch breaks. Among the changes observed in men attending these clinics was a 68% decrease in absenteeism over a two-year period for 1500 workers with cardiovascular symptoms (Brusis, 1961). Other studies have also indicated an improvement in work output and efficiency following the introduction of keep fit sessions (e.g. Petrushevski, 1966).

Men in the U.S. Marine Corps are claimed to be among the healthiest in the world (Melton, 1976). To join them a recruit has to pass a series of physical tests. Ann Hoiberg (1978) studied a group of 635 recruits who had narrowly failed this entry requirement and who were undergoing a 30 day training programme in the hope of passing a re-test. The Comrey Personality Scales were administered before and after, and a significant change was recorded for 7 out of the 8 scales. There was an increase in trust, orderliness, social conformity, activity, emotional stability, extraversion and masculinity. Empathy was the only scale not to reveal a change.

While the changes in personality may appear to represent an improvement in personality resulting from an increase in fitness, it seems more likely that the changes represent an effect of Marine teaching. During the 30 day fitness programme, the recruits were also given military training and this included lectures on improving one's self-image and self-confidence. Since other studies have indicated little or no change in personality following a keep-fit programme, it seems that this teaching was responsible for the changes in personality scores.

As regards other studies, there have been a number of useful reviews. Scott (1960), Layman (1974) and Folkins and Sime (1981) are probably the most comprehensive, while Cooper (1969) has concentrated on research on the relationship between athletics and personality. Morgan (1974) has reviewed the literature on the physical condition of psychiatric patients, and the mental health of athletes. Hammett (1967) has summarised results of pre- and post-training studies; most of the studies in the literature instead look at differences on psychological variables in a comparison between fit and unfit groups, a procedure which clearly begs the question. Other reviewers (e.g. Clarke, 1958; Ismail, 1972; and Powell, 1975) have summarised the literature on the connection between physical fitness and cognitive function, which is only marginally relevant to this section.

We now turn to an examination of an experiment on the influence of exercise on personality. A group of 56 middle aged faculty men at Purdue University volunteered for a 4 month fitness training course (Ismail and Young 1976)). The 16PF was administered before and after this course, together with various measures of fitness. While personality was related to fitness level, there was no clear indication of a change in personality as a result of increasing fitness. Since 4 months may not be long enough for personality changes to occur, Young and Ismail (1977) followed up 48 of these men 4 years later. Personality changes were still not apparent, even among those who had remained active since the fitness course. Other studies on the effects of a fitness training course indicate a similar conclusion of little change. For example, Calandra (1971), Ismail and Trachtman (1973), Ismail and Young (1973), Buccola and Stone (1975), Mayo (1975), Tillman (1965), Werner and Gottheil (1966), and Naughton *et al.* (1968). As Folkins and Sime (1981) point out: "It appears that there is no evidence to support the claim that global changes on personality tests follow from fitness training". (p. 380.) It might be argued that the lack of reliability of the 16PF scales, or the lack of psychological meaning of the MMPI scales would ensure such negative findings, but the fact remains that there is on the whole no evidence for any beneficial effects of sports training on personality. Possibly longer periods of training might have a greater effect, but such a suggestion cannot at present be based on empirical material.

Changes in self-concept have been reported more frequently. As Layman (1974) pointed out: "Of seven studies involving tests of self-concept before and after a physical development programme, four reported improvement in self-concept or body-image ... and three reported no significant change". (p. 43.) As Folkins and Sime (1981) show in their review, research since then has generally confirmed the belief that fitness training improves self-concept. Relevant studies are those of Martinek *et al.* (1978), Bruya (1977), Collingwood (1972), Hanson and Nedde (1974), Hilyer and Mitchell (1979), MacGowan *et al.* (1974), Collingwood and Willett (1971), and Mauser and Reynolds (1977). Three of these studies are truly experimental, in the sense of including random assignment to programmes and all have reported positive results; this is important as it obviates a criticism often made of such studies.

Heaps (1978) has argued that a person's information about fitness and its expected effects may influence his self concept, and this may indeed play an important part in the results (Leonardson, 1977; Leonardson and Gargiulo, 1978). These different effects are difficult to disentangle experimentally.

While it might not be expected that participation in an exercise programme would be sufficient to cause changes in personality, it might be expected that changes in feelings of well-being would occur. Folkins (1976) administered the Multiple Affect Adjective Checklist to 36 men at high risk of coronary artery disease. Half this group underwent a 12 week exercise course, and, relative to the other half, there was a significant decrease in feelings of anxiety and depression.

In a similar study with college students, 21 female students who completed a semester-long jogging course showed a significant improvement in anxiety, depression, self-confidence, adjustment and sleep (Folkins *et al.*, 1972). Results for a group of 21 men were not significant. It was intended that students who enrolled in an archery or golf course would serve as controls. Such a control group is necessary if any changes in mood states are to be attributed to an increase in fitness rather than to an interest in a new activity (Hawthorne Effect). But unfortunately the pre-training scores of the jogging group were worse than those of the control group, and so a direct comparison was not made.

Folkins and Amsterdam (1977) summarise the results of a number of studies (e.g. Carter, 1977; Snyder and Spritzer, 1974; and Morris and Husman, 1978) usually resulting in positive outcomes. Allied to these findings are observations that there also results a relief from anxiety and other types of psychological distress (e.g. DeVries, 1968); Folkins *et al.*, 1972; Joesting, 1981; McPherson *et al.*, 1967; Morgan *et al.*, 1970). None of these, unfortunately were truly experimental designs, and hence there is no control for self allocation. As Folkins and Sime (1981) point out: "Too often experimental fitness training is offered to specially recruited subjects who seek out exposure to the training. This selection bias is a serious problem in any attempt at comparison with controls". (p. 378.)

Another set of studies is concerned with social behaviour and adjustment, as reviewed by Stevenson (1975). These studies, unfortunately, again concern comparisons between groups differentiated with respect to fitness, but little empirical evidence is available along the lines of a properly designed experimental study. Greenberg (1976) used a random allocation device and found some positive change, but much of the improvement over a no-training control group was probably due to the interpersonal functioning training, which was also given to the two experimental groups, one of which also received fitness training.

Studies on cognitive effects of fitness training have often been related to theories originating with Piaget (1936). Clarke (1958) put forward the view that learning potential would vary linearly with physical fitness level, but in his review Harris (1973) reported failure to find any support for this hypothesis. Gruber (1975), came to the opposite conclusion, and empirical results are equally discordant (see for instance Ismail, 1967, and O'Conner, 1969) the first of whom reported positive, the second negative results. Folkins and Sime (1981) quote a number of other studies, and conclude that: "Attempts to improve cognitive functioning through fitness training has been successful with geriatric mental patients, but results with children and normal adults are unclear. Fitness training does appear to promote functioning during and after physical stress." (p. 376.)

We have noted the almost universal tendency to study groups differentiated with respect to training, but presumably self-selected, so that it would be impossible to attribute any observed effects to the training itself. One way of helping to ensure that the two groups have similar pre-training scores is to randomly assign the subjects. This was done by Greist *et al.* (1979) in a comparison of jogging with psychotherapy. Eight psychiatric patients suffering from depression completed a ten week jogging course. Their scores on the Depression Symptom Checklist improved during this time, but a similar improvement was recorded by the control group receiving psychotherapy. This improvement may reflect the benefits of jogging and psychotherapy or it may simply reflect the tendency for patients, when repeatedly assessed, to rate their symptoms as less severe. If the improvement was genuine, however, it may be noted that the jogging was estimated to be four times more cost effective than the psychotherapy.

There has been much debate on the psychological effects of intensive competition, especially on children. But few investigations have been directly aimed at providing answers to this question. Ogilvie (1970) studied children in the exclusive Santa Clara Swim Club, using a battery of personality measures. Comparing 10 year olds with 14 year olds, he concluded that there was an increase in extraversion with age. In particular, the older swimmers tended to be higher on self-assertion, independence and aggression. Whether this difference is due to the effects of intensive competition, or of being a member of a thriving club is not clear.

In order to disentangle such effects, it is necessary to incorporate a control group in a longitudinal design. Tattersfield (1975) has done this in a study of 106 swimmers, aged 11–14 years, involved in regular competition in the north-east of England. Compared with an individually matched control group of 106 boys not involved in competitive sport, there was a significant increase in extraversion and a decrease in anxiety and independence over a two-year period.

Using the Guilford Zimmerman Temperament Survey, Johnson (1966) found an increase in ascendance and sociability over the season in schoolboy American football players at the sophomore level relative to a control group. But the result did not hold for other age groups. Whether this is just a chance difference or whether it means that boys at the sophomore age are more prone to changes in personality is still open to question.

Tillman (1965) studied 386 high school junior and senior boys, who were administered a physical fitness test. The boys who finished in the upper 15% on the test were compared, by use of a battery of three personality tests, with the boys who were in the lower 15%. The upper group had a significantly higher ascendance rating on the Allport A-S Reaction Scale, and on the Cattell Scales the upper group scored significantly higher on factors F (enthusiastic), while the lower group scored significantly higher on Q₂ (self-sufficient) and Q₄ (tense). On the Kuder Preference Record, the upper group scored significantly higher on outdoor, mechanical, scientific and social service activities, while the lower group scored

significantly higher on computational, musical and clerical activities. These differences are all in line with what one might have expected on the basis of previous work.

Of interest in this section is the second phase of the study, when the low physical fitness group was divided into a control and an experimental group. A nine-months' physical fitness programme for the experimental group resulted in a significant gain in physical fitness, but when compared with the control group changes during the experimental period, the experimental group personality trait changes were found to be significantly different on only one test item — which, in view of the large number of test items, is almost certainly a chance effect. Thus on this study there was no effect on personality of training in physical fitness.

One possible source of difficulty may be the interaction with personality of the training and competitive effects. Few studies have been concerned with individual differences in response to exercise or competitive sport. That such a relationship is likely is indicated by studies in other fields. For example, Stoudenmire (1972) found that relaxation training was more likely to lower anxiety in introverts than in extraverts. With regard to sport, there is comparable evidence concerned with learning to swim. Several studies have indicated that non-swimmers tend to be introvert in personality (e.g. Behrman, 1967; Meredith and Harris, 1969; Whiting and Stembridge, 1965). Hardy and Nias (1971) went a step further by giving swimming lessons to 10 year old non-swimmers. The children were assessed on a variety of physical and psychological measures, and these variables were correlated with their response to the swimming lessons. The time taken to learn to swim a length of the pool was significantly correlated with extraversion; the coefficients were 0.72 for a group of 15 boys and 0.50 for a group of 14 girls. The correlations with the other variables were lower and not significant. In a similar study involving 11 boys, Williams (1970) obtained a 0.74 correlation with extraversion.

A relationship between extraversion and learning to swim might be explained in several ways. First, extraverted children may be less afraid of the water because they have not developed conditioned fears to such an extent as introverts. Second, extraverts may be better at learning motor as opposed to cognitive tasks. Third, extraverts may simply be more interested in the novelty and challenge of learning to swim. It is difficult to choose between these interpretations and, indeed, all three may have played a part. The whole field is complex, and interpretations of individual studies difficult. Yet in view of the widespread belief in the character-building effects of sport, and its prophylactic effects on potential neurotics, and criminals, more and better-designed studies should be encouraged: this clearly is an important problem.

To the effect of exercise and competition, treated in this section, we may perhaps add the possible contribution that behaviour modification can make to sport (Bregelmann, 1981). Essentially, this consists of the application of psychological knowledge to the improvement of performance in sport, and covers such topics as the setting of goals, knowledge of results, shaping of behaviour, positive reinforcement, the use of token economies, the use of contingency contracts, and many other methods. Behaviour modification has not been used as widely as its possible usefulness would suggest, but Bregelmann's paper leaves little doubt that it holds out high hopes of improving the performance of many sportsmen and women. To this should be added the possibility of using behaviour therapy for the reduction of anxiety through such methods as desensitization, flooding, modelling, etc. In view of the fact that little explicit research has been reported in the literature, little more can be said about the use of these methods at the present time; its promise vastly outweighs its achievement so far.

This may be the appropriate place to add a few words concerning another factor which has been used separately or in addition to exercise and competition to affect performance, namely the use of drugs (Williams, 1976; Ryan, 1976; Hanley, 1979; Burks, 1981). If it be queried why papers on drugs are referenced and discussed in an article dealing with personality and sport, the answer must be that there is an important interaction between psychopharmacology and personality (Eysenck, 1981b), and that such an interaction is vital in considering such research as has been done in the field. This interaction is particularly strong in relation to stimulant and depressant drugs, and as the former, particularly

amphetamine sulphate, has played a large part in the work that has been done, the failure of research workers to pay attention to this interaction is particularly deplorable.

Amphetamines have been found in laboratory animals to prevent or reverse fatigue, so that the duration of adequate performance in rats and other animals is prolonged before fatigue appears, and the effects of fatigue can in part at least be reversed by amphetamines. Other effects are wakefulness, alertness, elevation of mood, confidence, ability to concentrate, elation, euphoria, and an increase in motor activity; it is hardly necessary to emphasise that these are precisely the effects which would be sought by athletes.

In relation to human sports performance, the work of Karpovich (1959) and that of Smith and Beecher (1959) is of particular importance. The latter authors studied three types of athletic performance, namely swimming, running and putting the shot. Amphetamine was found to produce small but consistent improvements in performance, amounting to something like 1% in swimming, 1.5% in running, and 3–4% in putting the shot. It was noted that some subjects performed better after placebo than after amphetamine administration; this indicates the importance of individual differences in personality factors which should certainly be measured directly in future work.

If relatively small doses of amphetamine have the effects of increasing arousal, it should be noted that massive doses, ranging from 50 to 150 mg or more, may produce a prepsychotic, paranoid rage state which is sought after by some professional football players who take such large doses in the hours preceding a game. As Burks (1981) points out: "The 'analgesic rage' induced by massive doses of amphetamines produces a prolonged temper tantrum that partially explains the violent, aggressive behaviour characteristic of certain professional football players. Like humans, rats have been reported as being more aggressive when given large doses of amphetamine." (p. 115.)

There are of course also negative effects of amphetamine and amphetamine-like drugs, such as nervousness, restlessness, tremors, insomnia, cardiovascular disturbances, dizziness, and gastro-intestinal disturbances. The "analgesic rage" phenomenon may be followed by profound depressive reactions.

This is clearly an important area to explore, but the failure of investigators to pay attention to individual differences in personality makes it undesirable for us to go further into this field. Ethically it is of course highly undesirable that sportsmen and women should have recourse to drugs of any kind to improve their performance, but human nature being what it is banning such practices will only be effective if breaches can be detected readily, and punished appropriately. From the psychological point of view the effects of drugs on performance are varied and important, and advances have been made recently in an understanding of the interaction between these effects and personality (Eysenck, 1981b).

10. PHYSIQUE AND PERSONALITY IN SPORT

There is a large body of literature on physique or body-build and its relation to personality. This has been well reviewed by Rees (1973), and by Eysenck (1970). The most widely used system relates body build to embryological development, and derives from the work of Sheldon (1940, 1942) who in turn derived much of his thinking from Kretschmer (1934), and Kretschmer and Enke (1936). These types are illustrated in Fig. 10, which also contains several terms descriptive of these types, used by various authors. The terminology introduced by Sheldon (mesomorph, for the athletic muscular type; endomorph, for the pyknic, digestive type, and ectomorph for the asthenic, leptosomatic type) will be used here.

It should be noted that Sheldon's system has been criticized on statistical grounds, in that two dimensions are sufficient to account for all the variance involved in body build (Rees and Eysenck, 1945), and also because the embryological development hypothesis has not found any support in the literature. However, in view of the fact that most of the work done on the relationship between sport and physique has used Sheldon's system, we will adhere to it at the descriptive level.

Sheldon believes strongly that there is quite high correlation between body build and temperamental type, and he recognises three of these personality types, labelled

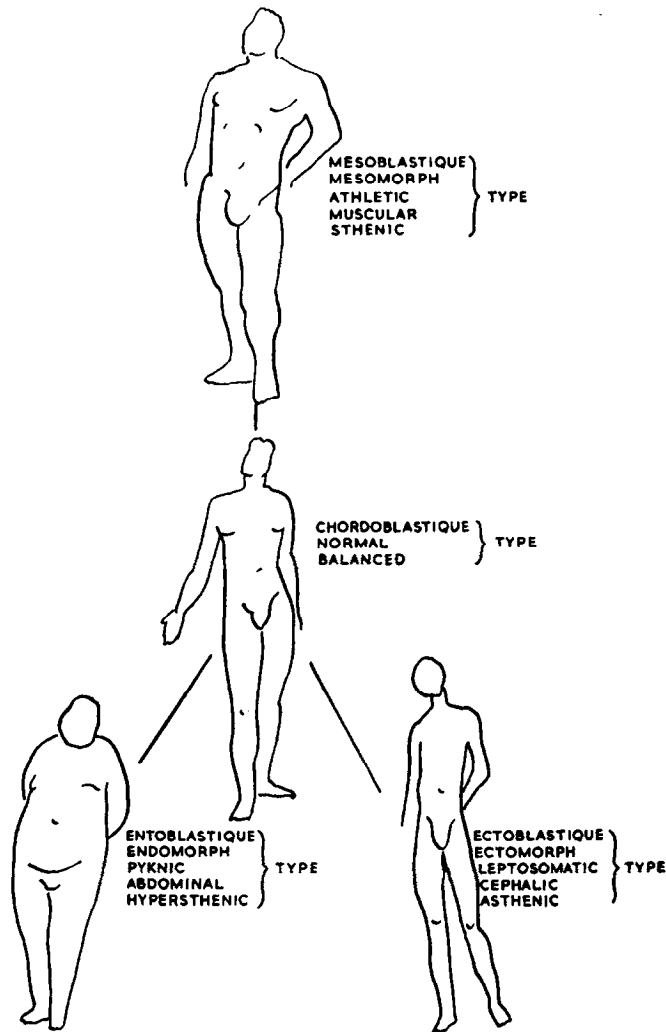


FIG. 10. Martiny's diagrammatic representation of three main body types derived according to the hypothesis of embryological development.

viscerotonia, somatotonia, and cerebrotonia, according to whether the gut and stomach, the muscular part of the body, or the brain are predominant. He originally reported correlations between endomorphy and viscerotonia of 0.79, between mesomorphy and somatotonia of 0.72, and between ectomorphy and cerebrotonia of 0.83. He argued that "these are higher correlations than we expected to find, and they raise some questions of great interest. If we were to regard the product moment correlation as a measure of the degree to which the variables are made up of common elements, correlations of the order of 0.8 would suggest that morphology and temperament as we measure them may constitute expressions at their respective levels of essentially common components." Not only is this statistically incorrect, as the proportion of common components is the square of a correlation coefficient, and hence 64%, or only just over half; the correlations themselves are absurdly high, and due to the fact that the author himself, knowing the physique of the subjects also rated their temperament! Later work, summarised by Eysenck (1970), Rees (1973) and Zerssen (1980) has suggested very much lower correlations, not exceeding 0.4. Child (1950) administered adjective check lists based on Sheldon's Temperament Scale to college men, and Cortes and Satti did the same with adolescent boys; they found correlations with body build in the same direction as had Sheldon, but much lower. Where Sheldon's correlations averaged 0.8, theirs averaged 0.35, ranging from 0.13 to 0.42. Washburn (1962) found that mesomorphs were more likely than other boys to rate themselves as dominant. As Montemayor (1978) points out: "All of these findings suggest that to some extent males with different physiques

describe themselves in characteristically different ways, with the strongest association between mesomorphy and the traits of assertiveness and dominance" (p. 56) — both of which are of course characteristic of extraversion. (See also Walker, 1962, 1963; Davidson *et al.*, 1957; Hanley, 1951; Cabot, 1938; Eysenck, 1947, and Seltzer, 1945, for further support of this position.)

There is fairly general agreement that correlations of the order of 0.4 are obtained between introversion and ectomorphic physique, and extraversion and mesomorphic physique. In addition there are correlations of roughly the same size between N and small body size, as measured by multiplying height by width. Quite generally, comparing Eysenck's with Sheldon's typology, extraversion correlates positively with somatotonia and viscerotonia and negatively with cerebrotonia, while neuroticism correlates with cerebrotonia (Metzner, 1980).

There are two major sources for a consideration of physique and athletic prowess, namely Tanner's (1964) "The Physique of the Olympic Athlete", and Eiben's (1972) "The Physique of Women Athletes". In addition, books by Tittel (1965), and Jokl and Jokl (1968) may be considered. Tanner's book is essentially concerned with the study of 137 track and field athletes at the 17th Olympic Games in Rome, 1960, and a comparison with weight lifters and wrestlers. A good impression of his general results can be gained by comparing the somatotype distribution of 4,000 American college students (Fig. 11) with the somatotype distribution of 114 Loughborough physical education training college students (Fig. 12), and the somatotype distribution of 137 Olympic track and field athletes (Fig. 13). It is startling to see how what we may perhaps call the lower half of the diagram, i.e. that oriented towards endomorphy or the "fat" component, is entirely missing in the records of the Olympic

SOMATOTYPES OF ATHLETES

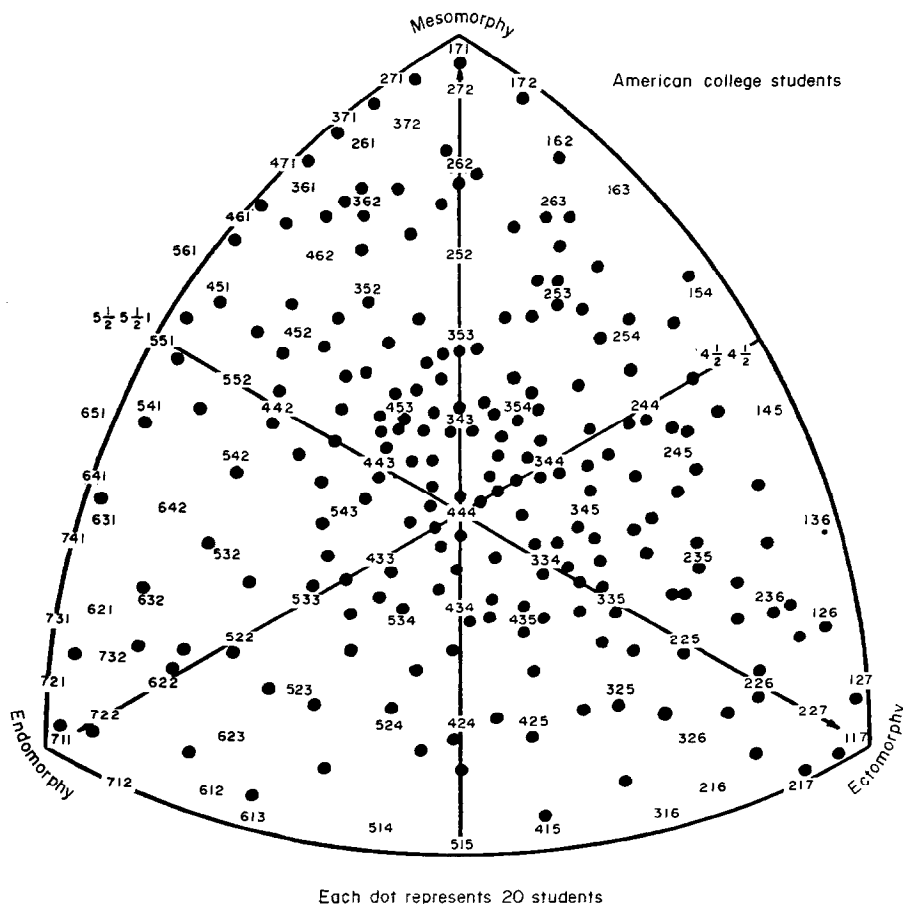


FIG. 11. Somatotype distribution of 4,000 American college students. (Sheldon, 1940.)

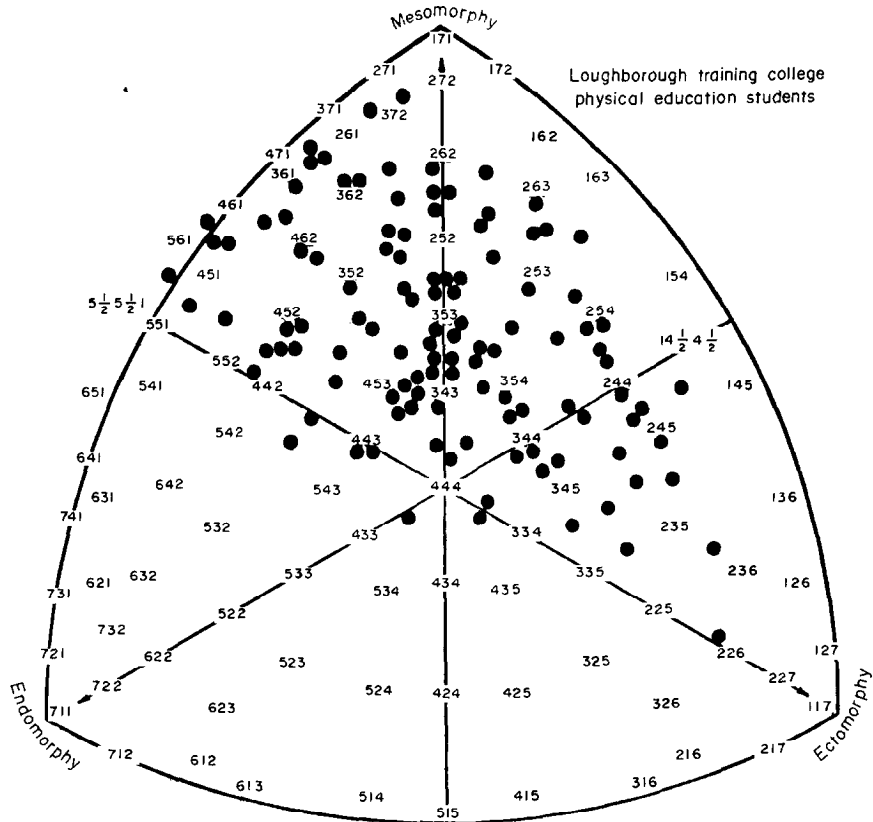


FIG. 12. Somatotype distribution of 114 Loughborough Training College students. (Tanner, 1964.)

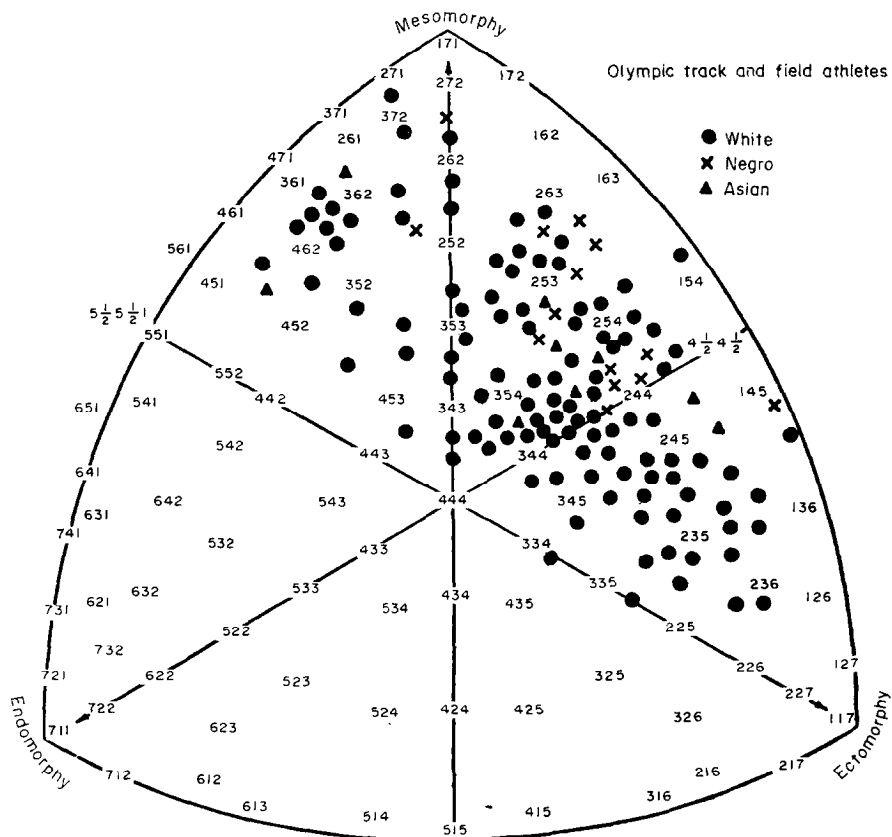


FIG. 13. Somatotype distribution of 137 Olympic track and field athletes. (Tanner, 1964.)

athletes, and almost entirely missing in the physical education students. The major tendency in both cases is towards mesomorphy, i.e. the muscular component, with a respectable representation also of ectomorphy, i.e. the cerebral component, as long as this is not exaggerated. As Tanner says: "the Olympic games is largely a festival of persons in the North-Eastern half of somatotype distribution. It is reasonable to suppose that a festival of the South-Westerly half of humanity would take a very different form." (p. 41.) The figures speak for themselves, and emphasize again the importance of extraversion-related personality traits for all types of sport.

Within-sport comparisons show some differences, which are dealt with in detail by Tanner. As he says, "We can sum up the track events by saying there seems to be a gradient of decreasing mesomorphy and increasing ectomorphy as we pass from the sprints through the 400 metres, to the 800 metres and the longer races. There is little indication, in this scanty data anyway, of a mean somatotype difference between the 800–1,500 m men and the longer distance runners. The sprinters and the 110 m hurdlers together stand out as being considerably more mesomorphic than all other track athletes."

There is an interesting comparison between middle and long distance runners, on the one hand, and weight lifters and wrestlers on the other. Figures 14 and 15 show the 800 m and 1,500 m runners, and the 5,000 and 10,000 m runners, while Figs. 16 and 17 show the weightlifters and wrestlers. Again the figures speak for themselves, with the runners clearly towards the ectomorphic end of the scale, and the weight lifters and wrestlers towards the mesomorphic end.

While individual athletes in each event vary around their means, many groups are very clearly differentiated from each other. Thus the 400 m and marathon runners differ very greatly, there being no overlap between them in several body measurements. There is also no overlap between the throwers and the runners; even single individuals can be sorted with assurance. As Tanner points out: "The explanation of the physical differences between highly successful athletes in different events must evidently lie in the differing mechanical

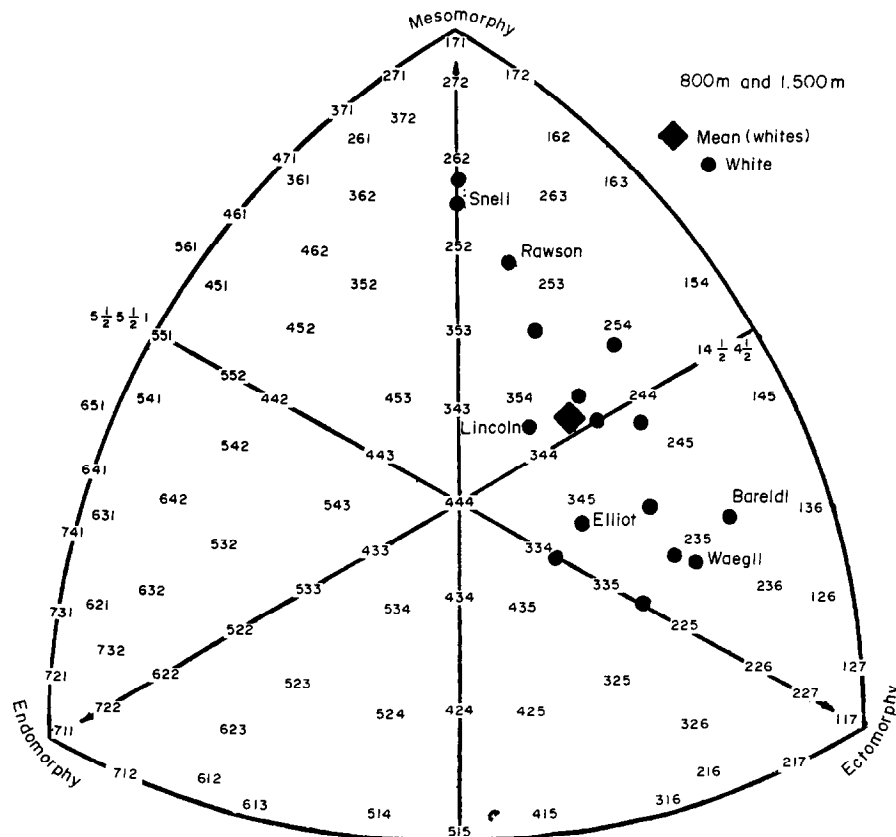


FIG. 14. Somatotype distribution of 800 m and 1,500 m runners. (Tanner, 1964.)

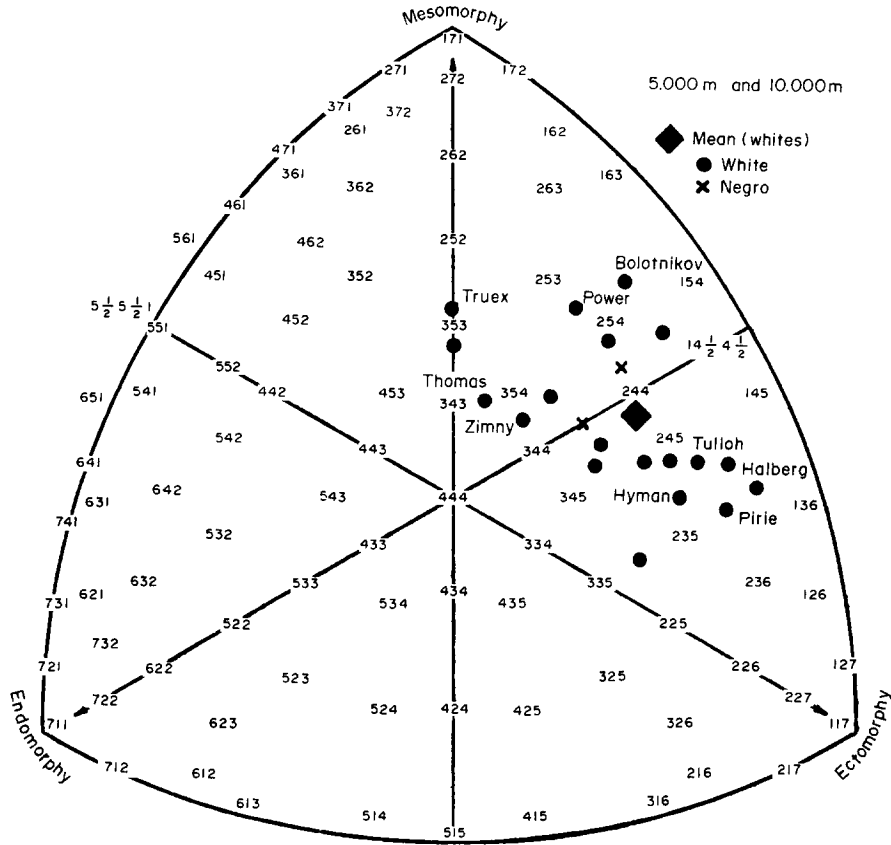


FIG. 15. Somatotype distribution of 5,000 m and 10,000 m runners. (Tanner, 1964.)

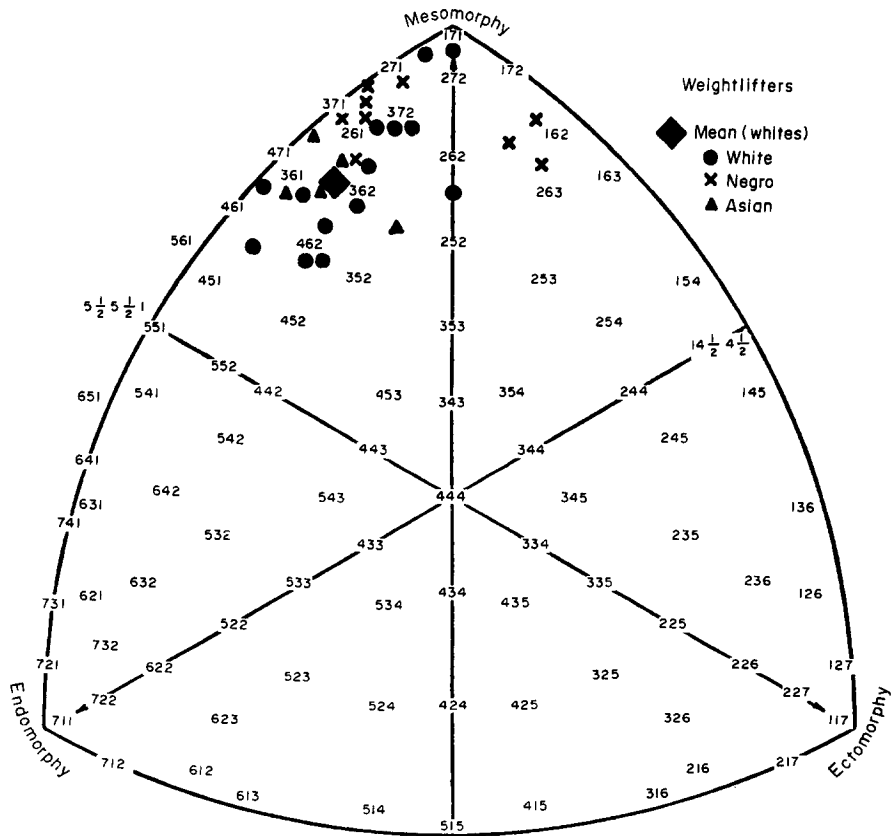


FIG. 16. Somatotype distribution of Olympic weight lifters. (Tanner, 1964.)

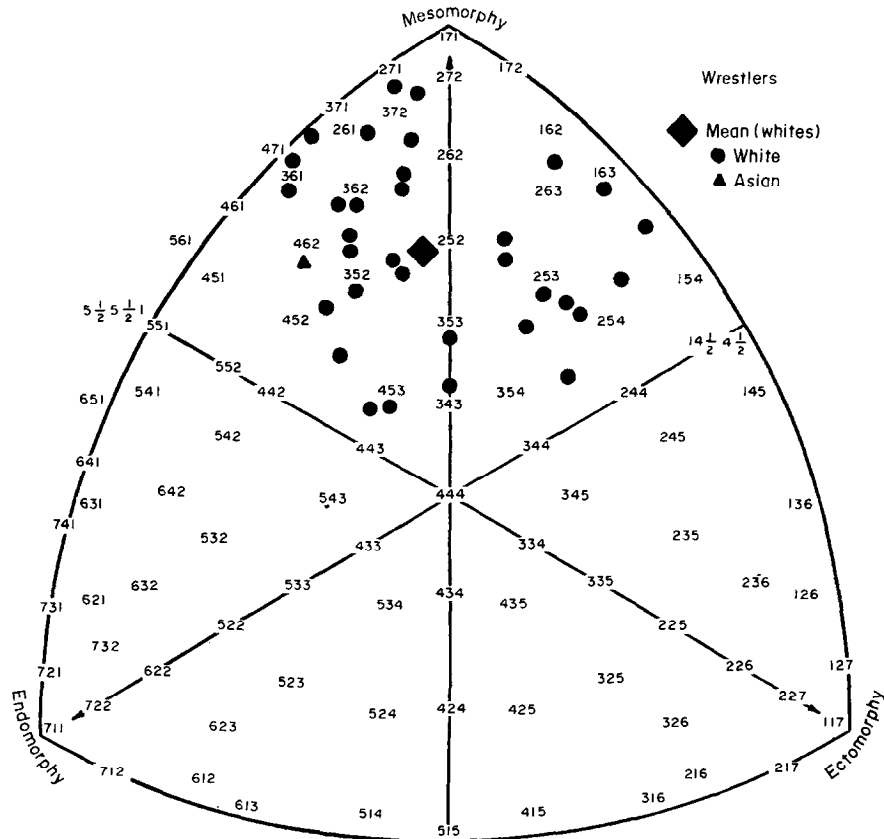


FIG. 17. Somatotype distribution of Olympic wrestlers. (Tanner, 1964.)

and physiological requirements of the tasks. The majority of successful athletes find, by trial and error, the task for which they are naturally most suited. There may be individual exceptions to this rule, but they are undoubtedly rare ... The most gifted of all may succeed in the events of their psychological choice; but one suspects that for each of these there are many others who batter at one gate of success in vain while another, unseen, lies open to them." (p. 108.)

The Eiben (1972) study did not use the Sheldon system, but rather made use of statistical analysis of body measurements and their interrelations. (It should be noted that Tanner also used body measurements in his work, but the stress was more on Sheldonian typology.) Figure 18 shows the body measurement factors involved, the major two dimensions which emerge from statistical analysis, and the fairly obvious grouping of these into three major types. As Eiben points out: "Relying on the body-measurement factors, one could provisionally call the upper left field *linearity field*, the lower left one *muscle field* and the lower right one *viscera field*" (p. 179). Thus Eiben's results too give us a typology similar to that of Sheldon.

The correspondence between Eiben's statistical analysis of body measurements, and Sheldon's system as used by Tanner, is shown in Fig. 19. As Eiben says: "In the author's system the *viscera direction* corresponds to endomorphy, the *muscle direction* to mesomorphy and the *linearity direction* to ectomorphy. Accordingly, a remarkable connection can be established between Sheldon's somatotyping method bearing certain subjective elements, and the authors own method which analyses the physique by means of normal components, i.e. most objectively, and founded on mathematical principles." (p. 180).

The detailed statistics given by Eiben are far too complex to be summarised, but in general it may be said that the women studied by him bear out the general features of the males studied by Tanner, both in relation to a comparison with non-athletes, and within-group comparisons. We may conclude, then, that generally mesomorphic body build helps in most

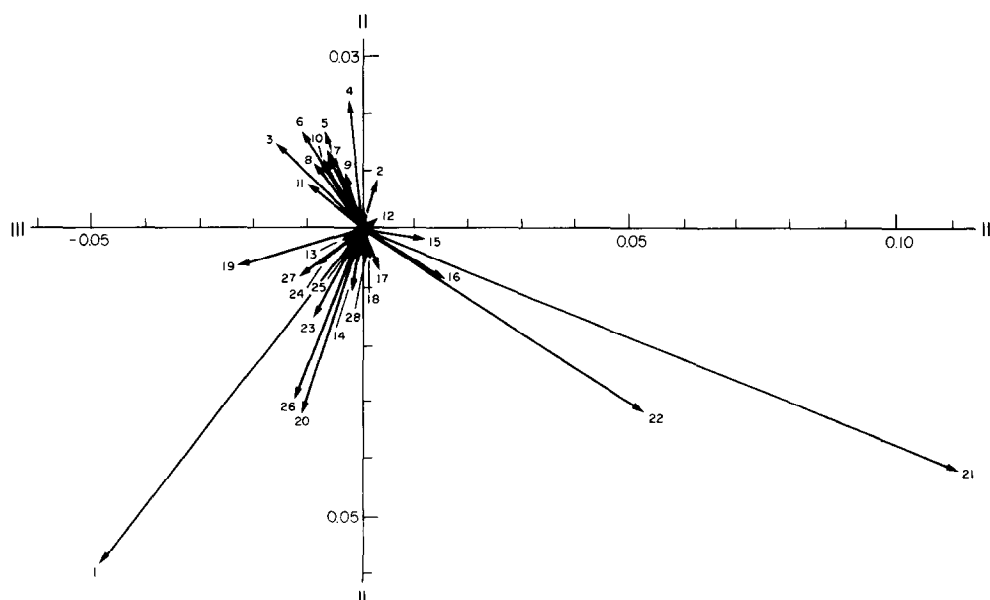


FIG. 18. Body-measurement vectors. 1. Weight, 2. Sitting height, 3. Span, 4. Stature, 5. Suprasternal height, 6. Shoulder height, 7. Elbow height, 8. Wrist height, 9. Finger height, 10. Height ant. sup. iliac spine, 11. Knee height, 12. Ankle height, 13. Shoulder width, 14. Bideloid width, 15. Bispinal width, 16. Bitrochanter width, 17. Chest breadth, 18. Chest depth, 19. Back width, 20. Chest circumference, 21. Abdomen circumference, 22. Trochanter circumference, 23. Upper arm circumference, 24. Forearm circumference, 25. Wrist circumference, 26. Thigh circumference, 27. Calf circumference, 28. Angle circumference. (Eiben, 1972.)

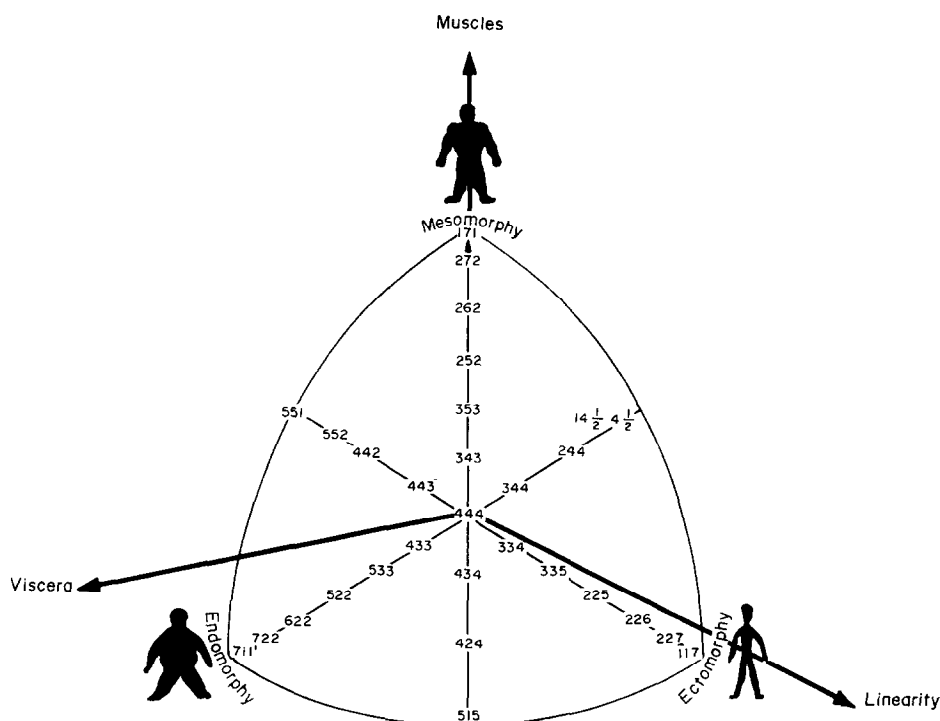


FIG. 19. Comparison of the main directions of body-measurement vectors and Sheldon's three components. (Eiben, 1972.)

sports which involve strength and sudden spurts of energy, whereas the ectomorphic component helps as far as endurance and long distance running are concerned. Endomorphy is uniformly bad, and practically non-existent in first rate athletes, although swimmers might provide an exception to this rule. Implications for personality are clear in that mesomorphy is related to extraversion; the overwhelming majority of sportsmen are therefore likely to be

characterized by extraversion, as we have already noted before. The longer distance runners might be an exception to the rule, but unfortunately we have no data on this.

The data given in this review strongly suggest a genetic contribution to a given person's ability in sport, as there seems to be little doubt that most of the body-build variables looked at have a strong genetic determinant, and as the evidence also indicates such a component for personality (Fulker, 1981). Weiss has carried out a study which supports this view (Weiss, 1977; 1978a,b; 1979). Compared with heritabilities just short of 0.90 for weight and height, Weiss found heritabilities of 0.85 for the 60 m sprint, 0.74 for long jump, 0.66 hop-step-and-jump, 0.93 for seven-minute endurance running, 0.71 for throwing a cricket ball, 0.85 for press-ups, and 0.71 for putting the shot. It is clear that these various sporting activities show a hereditary determination not much below, and occasionally (insignificantly) above those for physique. It should be noted, of course, that these values are derived from young children of about 10 years of age, who are twins, and few of whom are likely to be outstanding in any particular sport. Nevertheless, the data are valuable in indicating the importance of genetic factors in physique and sporting performance.

One variable related to physique which has only recently been investigated is that of left-handedness. It appears that in sports where extremely rapid reflexes are essential, left-handers do exceptionally well; the sports involved include fencing, tennis, basket-ball and boxing. Left-footedness is also associated with success in football, but only for certain positions. Examples are numerous. Three out of four fencing gold medals at the Olympics were won by left-handers, who took all the first eight places in the men's foil. In tennis, many left-handers appear in the top ranks, e.g. McEnroe, Connors, Vilas, Tanner and Martina Navratilova. In boxing too there is an unusually large number of "south-paw" champions. This pattern has developed in spite of historical evidence (Coren and Porac, 1977) that man has consistently been right-handed with over 90% of the population always favouring it. In sports where such reflexes are not essential (although of course in most sports they may still be very useful) right-handers do better than left-handers, when correction is made for the total numbers of each group.

The whole question has recently been investigated by Azemar (1970, (see also Guiard, 1981), who relates the difference to the well-known hemispheric brain differences in psychological functionings. The suggestion is that in most people the right half (governing the left half of the body) is best at making a very rapid synthesis of several pieces of information, while the left half (governing the right half of the body) prefers to handle its material piece by piece. It thinks logically rather than with flashes of insight.

Azemar makes the point that for the left-hander the direction for precise bodily positioning and reaction comes directly from the right hemisphere, whereas for the right-hander the messages have to travel from the right half to the left half through the corpus callosum, and then from the left half to the bodily musculature, thus adding a few milliseconds to the total time involved. While the theory is still in need of experimental support, the facts are very much as delineated. Azemar also notes personality differences between left-handers and right-handers, suggesting that the former are less orthodox, less predictable and more intuitive; whether this relationship with personality can be substantiated by proper research is of course another question. It is also reasonable to argue that part of the left-handers' success may be due to the upsetting effect that they have on the style of right handers. For example, in tennis left-handers will impart a spin to the ball which is the reverse of that usually encountered by the right-hander. The left-handed player will obviously be familiar with this reversal, however, for the right-hander this may be a more difficult adjustment to make.

Anecdotally, it is intriguing that of the three men who currently dominate men's tennis, Borg, McEnroe and Connors, the latter two are left-handed. At the present time (May, 1981) the current Association of Tennis Professionals world rankings contains four left-handed players in the top ten. This incidence of left-handedness decreases as we move further away from the top echelon of the game, although it still remains unusually high. With women this dominance of left-handed players is not as obvious. Perhaps this is because the speed and reflex components of the men's serve and volley approach to the game is less of a factor in the women's game, which emphasizes groundstrokes and baseline rallying. One exception to this

has been the left handed Martina Navratilova who has succeeded in women's tennis through the use of serve and volley tactics.

11. PERSONALITY AND STRATEGIES IN PHYSICAL SKILLS LEARNING

This section will deal very briefly, and necessarily inadequately, with a very important aspect of the personality-sport relationship, namely the development of certain strategies in performance which are themselves closely related to personality. This topic has been studied mostly by experimental psychologists, and direct work on actual sporting activities has not been forthcoming to any large extent, although the *Journal of Motor Behaviour* and the *Journal of Human Movement Studies* have in recent years printed a number of studies along these lines (but usually without reference to personality).^{*} In view of the lack of direct connection with sport, and the complexity of the topic, only one example will be given; the relevance of this example to sporting activities will be obvious. The work concerns tracking, more particularly pursuit rotor learning; in this type of activity the subject has to learn to follow with a stylus the movement of a target, and his scores consist of the number or duration of hits on that target. Examples of tracking in sport are of course innumerable. The tennis, squash or badminton player has to track the flight of the ball; the football, baseball, or cricket player similarly attempts to intercept balls whose flight has to be tracked; the racing driver, the runner, or the cyclist has to track the movements of his opponents relative to his own.

Much work has been done on the learning of tracking, and the reminiscence phenomenon which is so vital a part of this activity (Eysenck and Frith, 1977). Reminiscence is a technical term which refers to the fact that while practising the skill in question the subject shows very little improvement; when a rest pause is interpolated, however, a large improvement in performance is noted at the end of the rest period. This improvement used to be explained in terms of dissipation of reactive inhibition, following the Hullian theory, but it seems more likely that what is involved is consolidation of the memory trace (Eysenck and Frith, 1977).

Normally pursuit rotor work is done using a gramophone-like turntable with a metal disc set into the surface, which has to be tracked by a metal stylus. In the work to be discussed, Eysenck and Frith (1977) used a device displaying a moving light which could activate a photocell in the tip of the subject's stylus. Such a device gives a much clearer distinction between the states on and off target, the standard pursuit rotor involving a very poor quality of mechanical contacts. The photoelectric system largely obviates the difficulties, the target in this apparatus being provided by a radial strip of light set in a revolving turntable. Above this is placed a sheet of glass the underside of which is covered with light proof paper. Tracks of any shape can be made by cutting away the appropriate parts of this paper, and the target is then seen as a path of light moving around the track. A triangular track was used in the work to be discussed now, but a six pointed star track has also been used. Since all points on these tracks are not equidistant from the centre of revolution, the target changes speed, moving fastest along those parts of the track (the corners) which are further from the centre. These tracks are more difficult to follow than the simple circle of the standard pursuit rotor.

The variables usually measured in pursuit rotor learning are total time on target, number of hits, and average hit length. It can be observed that for *total time on target* there is a marked reminiscence effect (i.e. improvement in performance) after rest, but for the *number of hits* in each 10 second period, from which an average hit length score can be calculated, there is no reminiscence after rest. The differing course of change in hit length as opposed to total time on target suggests that the relationship between hits and time on target changes during the course of each session of work. This relationship has therefore been investigated in some detail. The relationship between hits and time on target is necessarily curvilinear, since there can only be few movements on or off target (and hence few hits) when the total

^{*}Some examples are: Gill (1978), Martenink (1969), Martens (1971), Martens and Landers (1969), Pargman and Inomata (1976), Payne and Huang (1977), Morris *et al.* (1975), Spielberger (1971), Thomas and Halliwell (1976), Weinberg and Hunt (1976) and Whiting and Hutt (1972).

time on target is either very low or very high. The simplest curve with these properties is a parabola, and Fig. 20 shows the best fit parabolas for 20 subjects in one of the experiments reported by Eysenck and Frith (1977). Half of these were extraverts, half introverts, and it will be clear that the two groups react quite differently, adopting different strategies. Some subjects achieve 50% time on target with many short hits, while others are achieving it with a few long hits. These may be referred to as *short hit* and *long hit* strategies, respectively, and there is a clear-cut relationship between these strategies and personality: extraverts tended to adopt a long hit strategy, while introverts adopted a short hit strategy.

Figure 21 shows the position of stylus in relation to the track for a subject with a *long hit strategy* (extravert), and Fig. 22 shows the positions of the stylus in relation to track for a subject with a *short hit strategy* (introvert). The performance of these subjects was filmed, and for each subject the position of the stylus in relation to the track was plotted for the frames of the film. The gross behaviour of these two subjects was revealed by this technique to be remarkably different. The subject with the long hit strategy followed a roughly circular course which therefore tended to cut the corners of the triangular track and also to swing out

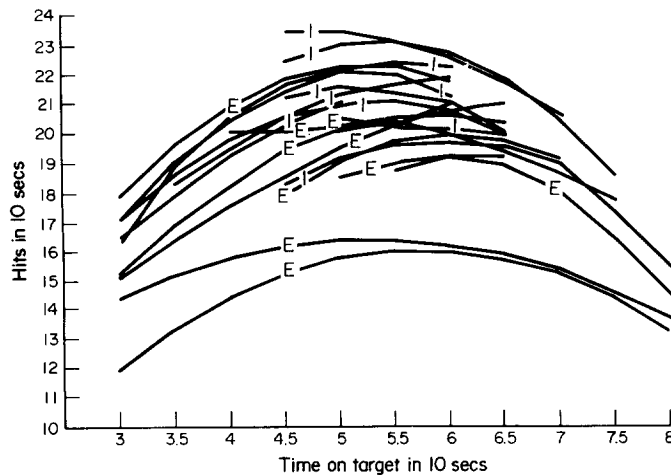


FIG. 20. The best fit parabolas relating time on target to average hit length for 20 subjects on a triangular pursuit rotor. E = extraverts; I = introverts. (Eysenck and Frith, 1977.)

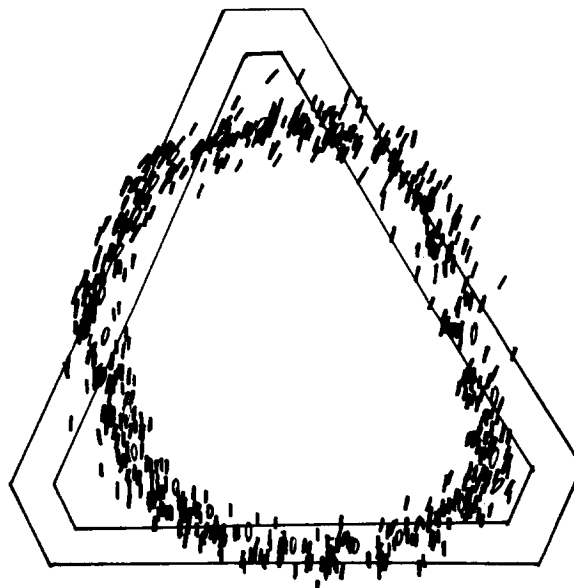


FIG. 21. Positions of stylus in relation to track for a subject with a "long hit" strategy (extravert). (Eysenck and Frith, 1977.)

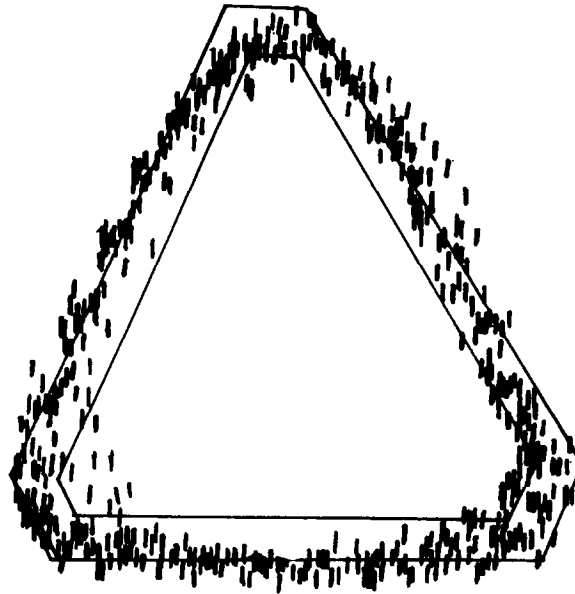


FIG. 22. Positions of stylus in relation to track for a subject with a "short hit" strategy (Introvert). (Eysenck and Frith, 1977.)

at the centre of each side. The subject with the short hit strategy followed a triangular course closely related to the track. Another difference between the two subjects lay in the relation between the tracking stylus and the position of the target. The subject following the circular course matched the *radial velocity* of the target very well, and was always radially in line with the target even though he was not always on the track. The subject following the triangular course, although nearly always on the track, was often in front or behind the target. He showed a strong tendency to be behind the target immediately after rounding a corner and then to catch up with it rapidly to the extent of overshooting, especially since in terms of linear velocity the target was slowing down at this stage.

These two types of performance relate to a cluster of measures which have been found to define the long and short hit strategies. The subject following a circular course and matching the radial velocity of the target must produce a *strong rhythmic component* in his performance relating to one revolution of the target. His cutting of the corners of the triangle will produce misses at regular intervals. The subject following a triangular course will not produce so rhythmic a performance. The subject following a roughly circular course will also produce a bimodal distribution of hit lengths. With such a path he will not only cut the corners of the triangle, but also will sometimes swing too far out from the center of the side. When this happens he will gain two hits with length approximately under half a side. When he does not swing too far out he produces one hit of approximately double length. Hits of intermediate length will be less frequent. This pattern of performance corresponds very well to the actual distribution of hit lengths found in these studies.

We can thus see that the long hit strategy involved matching the radial velocity of the target at the expense of its exact position. The short hit strategy involved attention to the exact position of the target. This involves trying to match the changing linear speed of the target and prevents making use of the much easier constant radial velocity. Thus it seems the major dimensions of strategy vary from an exclusive attention to the position of the target to an exclusive attention to the radial velocity of the target. At the same time the two strategies involve a high and a low rate, respectively, of detecting and correcting errors.

For an explanation of the differences observed, we may appeal to the well-known distinction between performance governed by *feedback*, and performance governed by *motor programmes*. Pursuit tracking consists of a discrete series of detections and corrections of mismatches between stylus and target. The simplest option open to the subject is to continue moving his tracking stylus in the same direction and at the same speed until he makes the next error correction. If the target changes its direction of movement fairly slowly

and infrequently and if the responses are made fairly rapidly in relation to the movements of the target, then performance of this kind would be reasonably successful. Such performance is entirely determined by the relationship between stylus and target each time the subject makes his detection and correcting response. In engineering terms we would describe this type of performance by saying that the relation between stylus and target produced by the system man/pursuit rotor was "fed back" into the system and used to modify the system's future behaviour. Thus we can characterize this kind of performance as being controlled by feedback. This feedback is visual, being the relationship between stylus and target seen by the subject. The subject who adopted the short hit strategy on the triangular track may well have been controlling his performance by feedback in this way. Thus he made frequent responses, followed the track of the target well, but failed to cope with the constantly changing speed of the target. Feedback of this kind is particularly useful where the movement of the target is relatively unpredictable.

However, it is characteristic of rotary tracking tasks that the future position of the target was very easily predicted. Instead of moving his stylus to the actual position of the target the subject can, from his knowledge of the target's future movements, move his stylus to the position the target will be in when he makes his next response. These sequences of movement which are controlled by previously acquired knowledge and not by immediate feedback have been called "motor programmes", and it is clear that by making use of these motor programmes the subject can make detection and correction responses at the slower rate. The subject with the long hit strategy who followed the circular course around the triangular track must have been making use of a motor programme. He had learned that the target moved around the track with a constant radial velocity. He then used this knowledge to anticipate his future position of the target. It was such anticipation that enabled him to cut the corners off the triangle.

Eysenck and Frith (1977) conclude, therefore, "that pursuit tracking involves two components. The first is the 'response' by which the relation between stylus and target is observed and the appropriate corrective movement is made. This is controlled by feedback. The second involves sequences of ballistic movements which anticipate those of the target and which, having been initiated, are continued without visual feedback. This is controlled by motor programmes. To be effective feedback control requires a high rate of responding, but does not require much knowledge about the movements of the target. Control by motor programmes requires the subject to make detection and correction responses as well, but the more effective his programmes become the less frequently he needs to make these responses." This difference is similar to that often researched in the literature as the strategy of "hunting" and the strategy of "ballistic movements". There are other studies to show that in motor movements introverts over-correct errors whereas extraverts under-correct errors, and this is what we would expect if these personality groups used strategies at each extreme of the dimension we have been discussing (Eysenck, 1967). Excessive dependence on feedback and error-correction would result in the over-correction of errors (introverted strategy) whereas excessive dependence on prediction and automatic control would result in a lack of attention to errors and hence under-correction (extraverted strategies).

In sport, it has become widely accepted that for outstanding players and performers, *anticipation* is an essential part of "reading the game" (Jones and Miles, 1978; Heldman, 1981), and this of course favours the extraverted type of performance. The introvert, relying on feedback, would not properly anticipate changes and hence would have to *over-correct*. For excellence in sports relying on some form of tracking, therefore, the extravert would appear to have adopted superior strategies, although of course in this we are making the assumption that with respect to the sensory and motor equipment necessary to carry out the task both extraverts and introverts are equally gifted.

The relationship between the experiments mentioned and sporting activity is probably somewhat tenuous, but the topic has been introduced into this monograph for the very good reason that future work on personality and sport could with great advantage take up the theories involved and apply them in a more direct fashion to the practice of various sports which rely particularly on tracking and anticipation. The work here cited is an example of experimental psychology and its concepts suggesting possible applications in the sporting

field, and interaction with personality, and the way in which such theories can be tested in the laboratory to make the field relevant both for experimental psychologists and to sports psychologists. At the moment there seems to be almost no contact between the two sides, and the work here reported is possibly an isolated beginning at building bridges between the two disciplines.

12. SUMMARY AND CONCLUSIONS

It is difficult to summarise and pull together results from such a very diversified field, particularly as there are few certain, replicated studies whose design appears good enough to make the results generally acceptable. In a summary such as this the qualifications noted in the text cannot, of course, be endlessly repeated, and hence what is said here should be regarded as suggestive rather than definitive. However, a number of general statements do seem reasonably well supported, although they should always be viewed with the qualification that what is true of outstanding sportsmen is not necessarily true of less outstanding sportsmen, and that conclusions which apply to one type of sport do not necessarily apply to another type of sport.

With these precautionary warnings in mind, we may note that the following are reasonably well supported:

- (1) Sportsmen and sportswomen tend to be characterized by an *extraverted* temperament. This seems equally true of outstanding performers as of average performers, physical education students, and others who are at a much lower level than Olympic participants or champions in various sports.
- (2) There are many different trains of argument leading from the low levels of cortical arousal level experienced by the extravert to the superior sporting performance characteristic of such individuals. Among these are: high pain thresholds, sensation-seeking, assertiveness and competitiveness, and generally a lack of cortical control and inhibition of ongoing behaviour and immediate reactions.
- (3) There is a tendency for athletes, particularly outstanding ones, to be *low on neuroticism*, and to suffer less from anxiety than do non-sportsmen and women. The findings do not support this conclusion universally, but the trend is definitely in this direction, particularly with outstanding sportsmen.
- (4) The reasons for the negative relationship between excellence in sport and anxiety-neuroticism lies probably in the *drive stimulus qualities* of anxiety, which distract the athlete from his appointed task. The situation is complicated because of the curvilinear relationship between anxiety as a drive, and performance; the Yerkes-Dodson law is often invoked in this connection.
- (5) There are few direct studies of the psychoticism-superego variable, but in general very successful athletes seem to have *higher scores on P* than do less successful sportsmen or non-sporting persons. Unfortunately, less work has been done with this variable than with E and N, but the results seem fairly well established.
- (6) The reasons for the relationship between P and success with sport probably lies in the aggressiveness of the high P scorer, his egocentricity, and his general competitiveness. It is possible that these qualities may be less apparent in team sports, where cooperation is necessary, than in individual sports, but there are no data to support this hypothesis as yet.
- (7) The body-build of the typical successful athlete is *mesomorphic*, a type of physique usually associated with *extraverted* personality types. The relationship appears stronger with the physical than with the personality type.
- (8) *Ectomorphic* body types can also be found among successful sportsmen, although not as frequently as mesomorphic body types, and never in extreme form.
- (9) *Endomorphic* body forms are practically never found among sportsmen and women, with the possible exception of swimmers. Even there the endomorphic component is not likely to be strong.

- (10) Body type is quite markedly related to *type of sport*, with long-distance runners being relatively ectomorphic, and wrestlers and weight-lifters being strongly mesomorphic. Short-distance runners seem to be intermediate between the other two groups.
- (11) The effects of sporting activities on personality are not really known, although there are many theories in this connection. It is often suggested that sporting activities may have a beneficial effect on personality, particularly in reducing depression and anxiety, but the evidence does not support such a view.
- (12) The effects of competition on personality are also not known, although here too there are many theories equally unsupported by good evidence.
- (13) Driving a car may be regarded as a sporting activity, and is quite definitely related to personality, in the sense that both *extraversion* and *neuroticism* are positively related to accident proneness. The combination of high-N and high-E is uniquely favourable for the occurrence of driving accidents.
- (14) Sexual activity too may be regarded as partaking of the characteristics of a sport, these activities being carried out in many cases for amusement, and being physical in nature. Here too *extraversion* has been found to be the personality component most commonly correlated with different types of sexual activity, such as early sexual activity, activity involving many different partners, activity indulged in frequently, etc. *Neuroticism* appears to have a negative influence on sexual activity, being associated with frigidity, impotence, lack of orgasmic capacity, and other disorders.
- (15) *State measures* of moods may correlate even more highly with athletic performance and sporting activity generally than do traits. Anxiety in particular has been found to be so related when state rather than trait measures are taken. The same is true of feelings of energy, competitiveness, and other similar states. This is a promising area which has not been investigated sufficiently.
- (16) Most investigations use groups which are too heterogeneous to give clear-cut results. It has been found that even in apparently homogeneous groups, such as shooters, different types of shooting are correlated with quite different personality traits, by depending on such things as time allowed for reaction to the stimulus, etc. Where little time is allowed, *extraverts* excel but where much time is allowed, *introverts* do quite well. Such finer distinctions should always be looked at in future research.
- (17) Physical skills learning, and the strategies which are being developed, are also related to personality, and this type of study has been done almost exclusively in the laboratory. An integration of this experimental approach with the study of sport-type situations could be of considerable importance in throwing a new light on the relation between sport and personality.
- (18) Genetic factors are known to determine to a large extent both personality and physique; it has also been shown that competence in many different sporting activities has a strong genetic component, accounting for between seventy and ninety per cent of the total variance. This finding does not suggest that training cannot help people to improve their performance, but it does suggest that selection for sport in general, and for specific types of sport in particular, should take account both of personality and physique.
- (19) Behaviour modification, i.e. the application of psychological principles to learning and improvement in sport, could be of considerable importance in leading to greater achievement in sport. The possibility of these methods have not yet been explored sufficiently to make any more definite statement.
- (20) The techniques of behaviour therapy (desensitization, flooding, modelling) could be of considerable use in reducing anxiety insofar as this interferes with optimum performance. Here the evidence for the general usefulness of these methods is very much stronger than in the case of the methods of behaviour modification, but little has been written about their application to sportsmen and women in particular. This illustrates the relative isolation of psychology from sport, and suggests that we already have methods of training and treatment which could with advantage be applied in this field.

We may conclude that there are undoubtedly fairly close relationships between

personality, on the one hand, and sporting activity on the other. These relationships must always be qualified by the *level of activity* reached by the competitor, by the particular *type of sport* indulged in, and even by *particular parameters* within a given sport. It will be extremely useful if in future personality tests were administered at an early stage in the child's life, and the child then followed up through the period of training and achievement. Data so acquired, in addition to those already available, should enable us to advise future athletes much more successfully than can be done at present. Such information should also aid us in a better understanding of the relationship between personality and sporting activity. Above all, research should be directed much more along the lines of hypothesis testing rather than using the more customary shot-gun approach of choosing multiphasic personality scales on a random basis and administering them to more or less randomly chosen sportsmen and women. Specific hypotheses, tested by carefully chosen instruments, are much more likely to advance our understanding in this difficult and complex field. Such hypotheses should come, on the one hand, from personality theory, and, on the other hand, from general experimental psychology. Putting these approaches together, the whole field is ready and open for research of an altogether higher quality than has been characteristic of the past two or three decades. There is already enough evidence available to show that the rewards will be considerable.

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