Talent Identification and Development:

An Academic Review

A report for **sport**scotland by

The University of Edinburgh

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Acknowledgements

Talent Identification and Development Programme
Academic Review

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Foreword

Sport is part of the very fabric of Scottish culture. In sport, we continue to find both enjoyment and success and over the years Scottish sport has produced many champions. Scots revel in success, a fact borne out by a recent survey that revealed 90% of those polled believed that success in international sport is important to Scotland (**sport**scotland, 2002).

The importance of developing and sustaining sporting success is one of the three visions of Scotland's national strategy for sport – *Sport 21: Nothing Left to Chance* – to recognise and nurture sporting talent. To support this vision, **sport**scotland, in early 2000, introduced a pilot Talent Identification and Development Programme (TID) to explore this area. It did so in partnership with three local authorities – Glasgow City Council, North Ayrshire Council and Scottish Borders Council – in a two-year programme working with young people between the ages of 10 and 12.

sportscotland's pilot programme used **Sport Interactive**, an interactive computer package. This computer package matches young people to sports based on performance of a number of simple physical activity tasks and the sporting preferences of the young people. **Sport Interactive** was developed from the Australian Sport Search programme and the Sports Council for Northern Ireland's Sports Counselling System.

In order to evaluate the validity and applicability of Sport Interactive as part of the TID Programme **sport**scotland commissioned the University of Edinburgh to produce an academic review. The academic review was to include a review of literature and research in talent identification and development with particular reference to models of practice used elsewhere in the world and covering both sport and other domains.

The University of Edinburgh has now presented **sport**scotland with the academic review. It highlights that currently in the UK the actual resources required for talent identification are concentrated on anthropometrical measures whereas the required resources should concentrate primarily on the psychological dimensions supported by the development of fundamental motor skills. Also, it identifies that talent is dependent on genetics, environment, encouragement and the effect of these on physical and psychological traits. It argues that by equipping young people with the appropriate psycho-behavioural characteristics of excellence and providing them with opportunities to develop, at an early age, the fundamental motor skills required for participation in a wide range of sporting activities that this will allow young people to reach their potential in sport and physical recreation. It also contends that by equipping young people with these competences that physical activity levels will be raised.

As a result of the findings of the review, **sport**scotland, in late 2001, decided to conclude the pilot programme using Sport Interactive and to redirect its talent identification and development work into a new programme – Developing the Potential of Young People in Sport (DPYPS).

This academic review was commissioned and is being published by **sport**scotland but the views expressed are the authors' alone.

SECTION 1: AN INTRODUCTION TO IDENTIFYING TALENT

1.1 Natural versus Scientific Selection

Talent identification (TI) is big business. From sports, through art, to education, researchers in all domains are attempting to find a way to identify the best in their field. However, finding the most effective, and most efficient TI method is a complex task, which despite its apparently recent 'rise' to prominence, has been a concern for quite a while. In the late 1960s and early 1970s many East European countries realised the weakness of the traditional TI programmes, and attempted to develop methods of identification which could be underpinned with scientific theory and evidence (Bompa, 1999). The results were (apparently) astounding; for example, eighty percent of Bulgarian medallists in the 1976 Olympic Games were the result of a thorough TI process. Similar results were demonstrated by Romanian and East German athletes in the 1972, 1976 and 1980 Olympics; successes again believed to be due to their scientific selection processes adopted in the late 1960s (Bompa, 1994). In other domains, such as dance (Baum, Owen and Oreck, 1996), art (Clark and Zimmerman, 1984), and education (Rimm, 1982, 1984) it also has become apparent that potential talent often is overlooked due to poor methods of identification. But still the $64,000 question remains; is there an optimally effective means of TI and, if so, what is it?

Traditional TI procedures have been categorised by many authors as 'natural selection' (e.g. Bompa, 1994, 1999), and in this setting, identification usually was aimed at individuals already in a sport. Of course, this sport involvement may have resulted purely from peer or parental pressure, proximity of facilities, or of the sport's popularity in that geographical area, and it would be coincidental for an individual who chooses a sport in this way to excel. For the majority therefore, who had not 'happened upon' their perfect match, performance evolution in the activity would be slow, as training would have to enable them to overcome innate deficiencies. Unfortunately, whilst East Europe has been moving away from this traditional approach such methods have persisted in the West until this day. Current initiatives, however, are aiming to adopt a more scientific selection process. By using scientific research to identify the criteria that elite athletes, musicians and artists possess, and the optimum environment for nurturing these criteria, we are likely to produce a larger number of outstanding performers. Individuals who fulfil the correct psychobiological criteria can be introduced to sports they might otherwise never have tried (Bompa, 1999), and chances of success consequently are raised. Such procedures, which aim to identify potential elite performers who are not currently involved in the sport in question, are normally referred to as talent detection programmes. Procedures that only consider the potential of current participants to become elite at a sport are normally referred to as TI programmes (see Figure 1.1). This distinction between talent detection and TI will be employed throughout this review.

Bompa (1999) presented a list of the advantages of utilising science to identify excellence, and this is replicated in Box 1.1. Although the list is aimed predominantly at sport, all five points can be applied to music, dance, art and education.

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> *Box 1.1: Advantages of using scientific criteria in the process of talent detection and identification (adapted from Bompa, 1999)*
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> 1. It substantially reduces the time required to reach high performance by selecting individuals who are gifted in sport
> 2. It eliminates a high volume of work, energy, and talent on the part of the coach. The coach's training effectiveness is enhanced by training primarily those athletes with superior abilities
> 3. It increases competitiveness and the number of athletes aiming at and reaching high-performance levels. As a result, there is a stronger and more homogenous national team capable of better international performance
> 4. It increases an athlete's self confidence, because his or her performance dynamics are known to be more dramatic than other athletes of the same age who did not go through the selection process
> 5. It indirectly facilitates applying scientific training, because sport scientists who assist in talent identification can be motivated to continue to monitor athletes' training.

A further advantage of a scientific approach is the objectivity that it provides. Coaching staff within a sport typically have carried out talent detection and identification, but although the ability of coaches to identify talented individuals should never be underestimated, it is a very subjective process (Williams & Reilly, 2000). In addition, for coaching staff to identify talent, individuals already have to be receiving training within that particular sport, or at least be available for viewing by the scouts involved. Of course, identifying individuals through their ability to display fundamental/basic skills and attributes means that aptitude rather than current levels of achievement can be identified (Baum et al., 1996), and consequently, Williams and Reilly (2000) highlighted the importance of discovering potential rather than developed talent. The 'pursuit of excellence' model presented in Figure 1.1 highlights the orthogonality of developed and potential talent (Russell, 1989). In direct contrast, traditional methods, those relying on natural selection, utilise stage two of the model (TI), virtually ignoring the talent detection phase (Williams & Reilly, 2000).

1. TALENT DETECTION
Discovery of potential performers who are not currently involved in the sport in question.

2. TALENT IDENTIFICATION
Recognising current participants with the potential to become elite performers. Predicting performance over various periods of time by measuring physical, physiological, psychological and sociological attributes (Regnier et al., 1993).

3. TALENT DEVELOPMENT
Providing athletes with a suitable learning environment so that talent can be realised.

4. TALENT SELECTION
Ongoing process of identifying at various stages individuals who demonstrate prerequisite levels of performance.

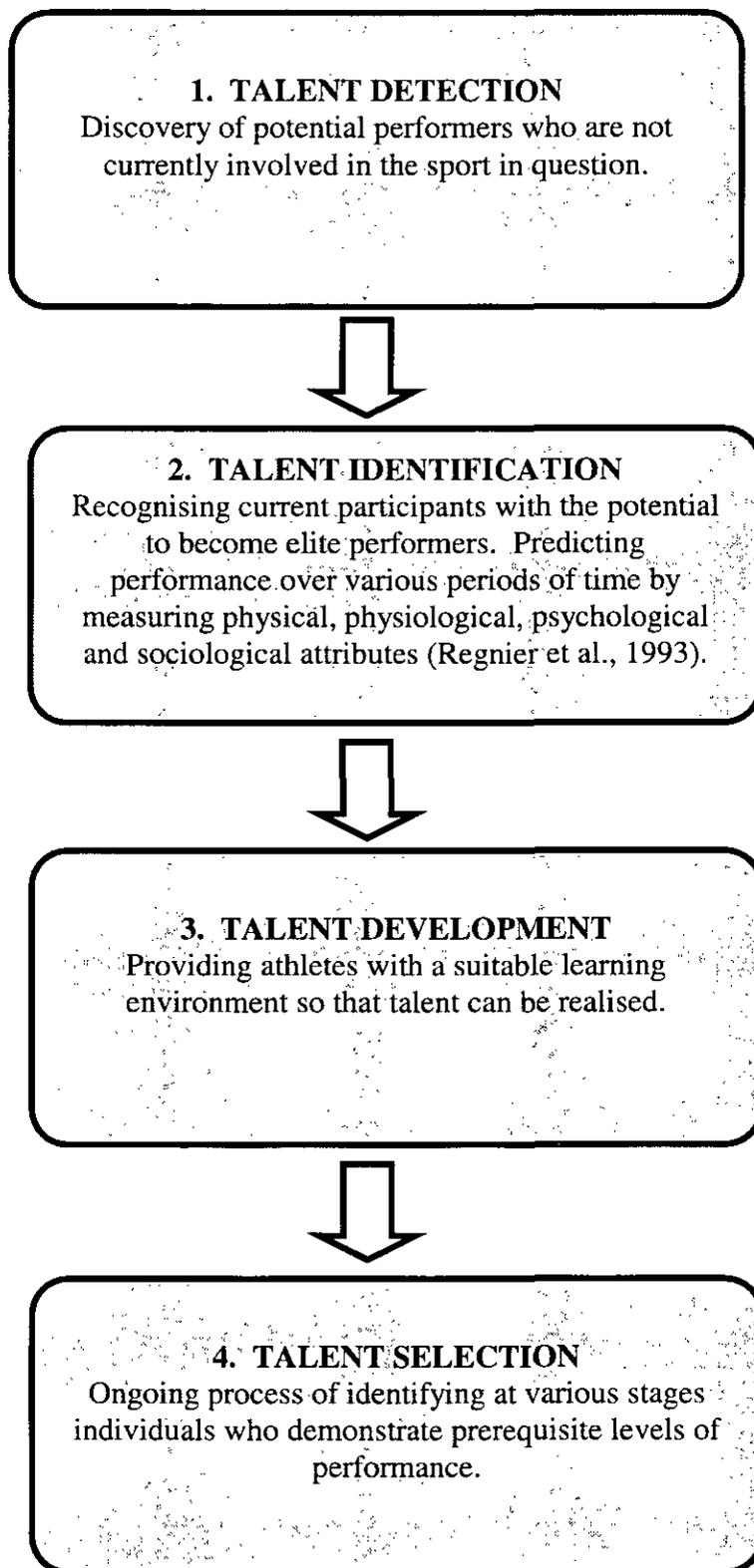*Figure 1.1.   Adapted from Williams and Reilly (2000) The Stages of the 'pursuit of excellence'*

The ongoing nature-nurture debate underscores the importance of combining talent detection/ identification and development (TID, e.g., Durand-Bush & Salmela, 1996, cited in Williams and Reilly, 2000), and despite the widespread belief that talent is innate, there is a growing body of evidence to support that genetic make-up plays a

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secondary role to the one played by the environment (e.g., Howe, 1999). The dictionary definition of talent includes the following, *"the ability to display exceptionally high performance in a domain that requires skills and training"* and *"an innate ability, aptitude or faculty"* (Collins English Dictionary). However, the belief that talent is innate implies that it is predetermined and relatively stable, that the course of its development cannot be altered, and that the environment plays a negligible role.

1.2 The Nature View - Arguments for and against

Researchers, through use of biographical information, have identified many phenomena which 'nativists' (proponents of the view that talent is innate) perceive support their beliefs. Firstly, accounts of individuals achieving brilliance in the apparent absence of opportunity (e.g. Fowler 1981, cited in Howe et al., 1996; Howe, 1999) are numerous, implying that the environment plays a minimal role in the development of talent. As a typical if non-topical example, Mozart's outstanding development has been well documented by many researchers (e.g., Howe, 1999). He was able to compose music by the age of four, was an accomplished performer on two instruments by the age of six, and demonstrated amazing feats of memory when he wrote out the complex score of *'Allegri's Miserere'* after hearing it just twice. (Of course, there is less evidence that, say, Steve Redgrave exhibited a similar level of early expertise!). In addition, there is a significant body of evidence indicating that certain individuals progress at a faster rate than other comparable individuals despite the lack of any substantial effort (Sloboda & Howe, 1991; Sosniak, 1985, in Bloom, 1985). Thirdly, demonstrations of a ceiling effect in performance, despite ongoing training (see Ericsson, Krampe and Tesch-Romer, 1993 for a review), has led researchers to conclude that performance is controlled by genetic factors. In sport, this approach has received considerable commitment and tacit acceptance, if less empirical support, and accordingly the next section will consider the support for the nativist position.

Despite these findings, it would not be sensible to argue that psychological and physical factors have no genetic origins; common sense (at least) tells us otherwise. It is also illogical to believe that such genetic factors are predetermined and stable. Ultimate levels may be predetermined, but are only obtainable with relevant experience, support and dedication. According to Darwinian models of talent development (TD), an individual's potential becomes actualised through evolutionary interaction of innate capacities and 'ecological niches' available in family, school and workplace (Simonton, 1999); so without the correct experience and opportunity optimum performance will never be achieved.

Of course, certain individuals do display skills and aptitudes at a young age, apparently regardless of experience. However, it does not automatically follow that these will lead to later TD, or even that individuals who lack 'innate precursors' will never excel. A youth's talent potential is not a stable innate trait but rather is constantly transforming during the maturation process. Not only may talent be lost, or never recognised due to lack of opportunities, but also one talent may metamorphose into another talent (Simonton, 1999). Thus, Mozart despite his innate abilities would never have achieved excellence without the opportunity and encouragement that he experienced. His first fully original composition was not produced until he turned

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twenty-one, but by this time he had been composing for at least ten years. In addition, his father, a highly ambitious music teacher, kept a very strict regime, and as a result, by the time he was six, Mozart is estimated to have notched up 3,500 hours of practice time (Howe, 1999). The likelihood of an individual achieving high levels of musical competence as a musician depends among other things on the availability of opportunities for learning. Mozart's amazing memory feats are also relatively easily explained. Even children can display well-developed memory skills within their area of expertise. If the information to be remembered can be connected to existing knowledge individuals appear to be able to remember phenomenal amounts of data (Howe, 1999; Howe, Davidson & Sloboda, 1996). In short, with the drive, support and opportunity furnished by his home environment, Mozart may have been anything, even an Olympic rower!

La Pieta orphanage in Venice provides further illustration for the crucial effects of a stimulating and supportive environment. A cultural ambience in which musical expertise was valued and encouraged, and numerous opportunities for training, resulted in a substantial number of orphans becoming accomplished musicians (Sloboda, Davidson & Howe, 1994); in fact, many more than would be expected from population frequency estimates. In this regard, Shinichi Suzuki (cited in Coon and Carey, 1989), the famous inventor of the Suzuki method of teaching was quoted as saying "Every child is born with the capacity for becoming richly musical so long as he or she is brought up properly...there is no inborn talent for musical ability".

Empirical data also supports the importance of creating the 'right' environment and opportunity. For example, Sloboda and Howe (1991) talked to 42 pupils of a specialist music school but the data indicated that individuals did not remember any early spontaneous involvement with music, and in all cases, lessons seemed to precede exceptionality. In addition, parents provided opportunities to practise and learn, and encouraged their children every step of the way; almost two thirds (n=28) had a musical instrument present in the house from birth. In fact, most children started music lessons because parents thought it was important and parents took a keen interest in their child's musical training. For example, 93% took a direct role in regulating practice, which was essential as only 6 of the 42 pupils interviewed were totally self-motivated.

Such differing degrees of opportunity and encouragement may be one possible reason for certain individuals advancing more quickly than their counterparts. However, all other factors being equal, it is still likely that some individuals learn and develop at a faster rate than others. Developmental patterns vary from person to person and, even within one individual, different components develop at different rates. During puberty, many talents undergo a rapid transformation in either a positive or negative direction (Bamberger, 1986, cited in Simonton, 1999), and the onset of development for any requisite trait may occur at any time, for any component, for any person (Simonton, 1999). In addition, opportunity and practice again play a role. Perkins (1981, cited in Howe et al., 1996) argues that the phenomenon of some individuals obtaining skills more quickly than others is due to the many hours of long and painful unobserved efforts onto which they can build. Howe and colleagues (1996) in a comprehensive review of literature concluded that ease of skill acquisition and development is affected by many factors, very few of which appear to be innate, for

example, training appropriateness. These factors are discussed in greater depth in subsequent sections.

In fact, evidence implies that level of practice can be improved beyond maximal by deliberate practice (Simonton, 1999); in other words, individuals have often exceeded their own expectations, and those of others. A change of training methods has been demonstrated to lead to performance increments even in individuals who appear to have plateaued. Thus, Hayes (1981) showed that all major composers without exception have required at least ten years of concentrated training in order to reach the highest degrees of mastery. Pablo Sarasate (violin virtuoso) stated "A genius! for 37 years I've practiced 14 hours a day, and now they call me a genius" (cited in Simonton, 1999).

Comparably long periods of preparation and training are equally essential in order to achieve high standards in other areas of accomplishment (in Howe et al., 1996). Some people do progress more quickly than others, but nobody attains the level of an international chess master 'with less than about a decade's intense preparation'. The only exceptions, Bobby Fischer and Salo Flohr, who have been cited often as such by supporters of the nativist position, were only a year shy of the prerequisite 10 years of preparation (Krogius, 1976 in Ericsson et al., 1993). In music, an average of 10 years of experience is necessary, with a further average of 20 years from starting to study until composition of outstanding piece (Hayes, 1981). Raskin (1936, cited in Howe et al., 1996) reviewed the careers of 120 important scientists and 123 poets and authors and concluded that on average more than 10 years had elapsed between first work and best work.

It is important to note that no individual cited in research has ever reached high levels of attainment in the absence of regular and frequent practice. Conversely, there is no account of anyone that practised for 2 hours/day but failed to reach high levels of achievement (Sloboda et al., 1994; Howe et al., 1996). Research on expert performance and expertise (e.g., Chi et al., 1988, cited in Ericsson et al., 1993) has also shown that important characteristics of experts' superior performance are acquired through experience and that the effect of practice on performance is larger than believed possible. However, it is not just the time spent practising that is important; training must be directed at improving or developing a skill. In this regard, the theory of deliberate practice differentiates between activity and purposeful, goal directed work. Deliberate practice requires time, energy, access to teachers, facilities and training materials, and is not inherently enjoyable. Findings indicate that if practice is appropriate, the more time an individual spends practising the faster they will develop (Ericsson et al., 1993).

It is possible that people practise longer and harder because of their innate talent (Williams & Franks, 1998, p.163); however, Sloboda and Howe (1991) demonstrated that children often would not practise if it were not for parental encouragement (in Howe et al., 1996). Children also practise more when they are progressing and finding practice pleasurable (Radford, 1990), even though the definition of deliberate practice outlines that it is not inherently enjoyable. In fact, studies investigating the development of talent indicate that individuals have to enjoy an activity before they can enter into deliberate practice. In the early stages of practice, especially with

children, motivation often comes in the form of parental or coach encouragement until practising becomes habit, a way of life (Sosniak, 1985, in Bloom, 1985).

For the theory of deliberate practice to be of practical use, more empirical information is needed about the way to practise, rather than about the amount of time to be spent in practice per se (Williams & Franks, 1998, p.163). Similarly, Kliegl, Smith & Baltes (1989) confirmed that intensity and quality of practice are as important as the sheer amount of it. In order to be of use, an account of exceptional performance must specify the environmental circumstances, such as the duration and structure of activities, and necessary biological attributes that lead to the acquisition of such characteristics and performance.

1.3 Summary and Overview of the Review

In conclusion, talent therefore appears to depend on genetics, environment, opportunity, encouragement, and the effect of these variables on physical and psychological traits. The question is no longer whether genetic or environmental factors determine behaviour, but how they interact. It is extremely unlikely that there is such a thing as a 'poetry gene' or a 'music gene', since complex human behaviours typically have a polygenic basis. Furthermore, such abilities are not inherited in a simple fashion. It is true that genetic factors are likely to contribute not only to specific abilities, but also to traits such as persistence, the capacity to concentrate and confidence (Lykken, 1998, in Howe et al., 1996). It also is likely that psychological qualities are indirectly influenced by genetic influences known as quantitative loci that affect human characteristics in a probabilistic rather than a predetermined manner (Plomin & Thompson, 1993, cited in Howe et al., 1996). In other words, psychological factors are affected by an individual's genetic makeup, albeit not in a stable rigid manner. Genetic factors will affect an individual's response to training and tuition, as genetics appear to underpin exposure to nurturing social and physical experiences (Lykken, 1998 cited in Howe et al., 1996). However, without the 'correct' environment, namely one in which the individual is encouraged and supported, and has opportunity to learn and practise, optimum performance will never be obtained. Consequently, talent detection and identification programmes not only need to be able to identify relevant psychological, physical and physiological characteristics, but need to be capable of identifying potential and developed talent. Underpinning such programmes with science can enable objectivity and aid in recognising individuals who have not yet received training in a certain domain. Lastly, it is difficult and possibly immoral to separate the processes of talent detection and development. Talent detection should be a continuous process, and should not be dependent on an individual's performance during any single audition, competitive event or performance test.

It must be recognised therefore that the identification of talent is complex, with many factors that must be catered for if the process is to be optimally effective. Accordingly, this report considers both the characteristics of effective talent detection and identification processes and the efficacy of current procedures. The review is sub-divided into 7 main parts: (a) talent detection and identification research, (b) conceptual models of talent detection and identification, (c) talent detection and identification practices in sport, (d) talent detection and identification practices out-with sport, (e) the dichotomy between empirical evidence and talent detection and

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identification practices, (f) theoretical models of talent development and current practices, and (g) conclusions. A brief outline of each of these sections follows.

Talent Detection and Identification Research (Section 2)

This section considers research that has contemplated the importance of performance determinants in the talent detection and identification process. Many have emphasised the need for processes to focus on innate factors. Accordingly, initial consideration is given to the possible use of anthropometrical and physiological measures as indicators of potential. However, it is argued that researchers and practitioners incorrectly have taken innate as tantamount to stable. Due to the instability of anthropometrical and physiological factors during maturation, the limitation of employing these factors to identify talent is highlighted.

Following on from a consideration of innate determinants of performance, the importance of fundamental movement skills (e.g., balance) to an individual's potential within sport is considered. Unlike anthropometrical factors, an individual's performance on fundamental movement skills will be partly influenced by the environment. Consequently, the importance of ensuring that all children have appropriate movement experiences prior to being tested on these skills is highlighted.

Finally, the role of psychological and behavioural factors in obtaining and maintaining world-class performances is considered. It is argued that, initially at least, psycho-behavioural factors are key in facilitating an individual to acquire skills and develop into a world-class athlete. Since experiences and the environment shape these behaviours, the importance of providing opportunities for individuals to develop the required skills is highlighted.

Conceptual Models of Talent Detection and Identification (Section 3)

A number of conceptual models of talent detection and identification are reviewed. Whilst the importance of recognising multiple determinants of talent is highlighted, in the majority of cases, no distinction is made between determinants of performance and determinants of potential. One exception is the multidimensional model proposed by Simonton (1999).

Talent Detection and Identification Procedures in Sport (Section 4)

This section analyses both British and worldwide talent detection and identification practices in sport, including the Australian Talent Search. The empirical weaknesses of both British and Non-British models are apparent. Where models have been reported as being successful, alternative explanations for sporting success are considered.

Talent Detection and Identification Procedures out-with Sport (Section 5)

Due to the complex problem of talent detection and identification, this section considers procedures that have occurred out-with sport. Particular emphasis is given to recent developments that have distinguished between determinants of performance and potential.

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Dichotomy between Empirical Evidence and Talent Detection and Identification Practices (Section 6)

This section emphasises and provides a possible explanation for the dichotomy that exists between current talent detection and identification procedures and efficacious procedures as indicated by research. The optimum environment for developing individuals who have the capacity to develop in sport is considered.

Theoretical Models of TD and Current Practices (Section 7)

This section, recognising the influence of the environment on developing potential talent, contrasts theoretical and practical models of TD.

Conclusions (Section 8)

The final section of the review provides an "action plan" for the future of TID. Future directions in terms of (a) research, (b) funding and direction of talent detection and identification schemes, and (3) potential outcomes of TID schemes are suggested.

SECTION 2: RESEARCH IMPLICATIONS FOR TALENT DETECTION AND IDENTIFICATION MODELS

2.1 A Review of Relevant Research in Talent Detection and Identification

This section will review and critically analyse past research procedures employed to develop talent detection and identification models. As the review will show, whilst performance is clearly made up of a number of dimensions, most research in this area to date has displayed a uni-dimensional focus, for example concentrating solely on the anthropometric dimension with little or no consideration of other factors or crucial interactions. The review highlights this weakness, and proposes an integrated model as the best way forward.

2.2 NATURE vs. NURTURE: Physiological and Anthropometric Correlates of Success

As early as the 1920s, researchers were examining the potential of anthropometrical (e.g., height) and physiological (e.g., strength) measures as discriminating factors between athletes involved in different sporting events. The list of variables considered was wide-ranging, from simple consideration of age, height, and weight to more extensive studies containing many anthropometric measurements, somatotyping, and tissue analysis. However, although numerous studies have contrasted senior and junior athletes, relatively few have examined the characteristics of the 'world-class' performer (see Table 2.1). Consequently, the rest of the review will focus mostly on those studies that have examined truly elite levels, rather than potentially 'cloud the issue' with the plethora of other available data.

	Track and Field	Boxing	Wrestling	Weight Lifting	Water-Polo	Rowing	Cycling	Marathon Runners	Swimmers	Diving	Canoeing	Gymnastics	Modern Pentathlon	Basketball	Sprinting	Hockey	Judo	Tennis	Triathlon	Speedskaters	Skiing
Anthropometrical and Physical Characteristics of Olympic Athletes																					
Kohlraush (1929, cited in Tanner, 1964)	X	X	X	X	X	X	X	X	X												
Correnti & Zauli (1964)	X	X							X												
Tanner (1964)	X						X														
Hirata (1966)	X																				
Tittel (1965)	X																				
de Garay et al (1974)	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
Van Der Walt (1988)		X	X	X	X		X		X			X	X		X	X	X				
Anthropometrical and Physical Characteristics of College Athletes																					
Bloomfield & Blanksby (1971)									X												
Piper, Ward, McGinnis & Milner (1987)																					X
Kroll (1954)			X																		
Anthropometrical and Physical Characteristics of Pre-Adolescent and Adolescent Athletes																					
Bloomfield et al. (1985)									X									X			
Bloomfield & Blanksby (1971)									X												
Ackland et al. (1989)																		X			
Ackland & Bloomfield (1996)																			X		
Pollock et al. (1986)																				X	
Calderone et al. (1987)												X									
Regnier & Salmela (1987)												X									

Table 2.1: Selection of studies that have looked at the physique of the Olympic, college and youth athlete

From as early as the 1928 Olympic games in Amsterdam (Kohlraush, 1929, cited in Tanner, 1964), researchers have exploited the opportunity to examine the elite athletes on show. As with the more broadly focused investigations, these studies have considered basic factors such as height, weight, and age (e.g., Jokl, 1964) to more extensive research on the size, shape, composition, and proportions of individuals (de Garay, Levine, & Carter, 1974). Initially, researchers primarily concentrated on the dimensions of track and field athletes. However, as the number of events within the Olympics increased, so did the range of athletes studied. Although statistical analyses within these early studies were limited, data consistently demonstrated that, irrespective of the nationality of athletes, distinct profiles were evident for individuals in a range of different sporting events.

The employment of the statistical procedure discriminant function analysis (Tanner, 1964) provided a unique contribution to the discussion of anthropometrical and physical differentiation. Tanner was able to identify groups of variables that best differentiated among athletes within different events. Consequently, distinct combinations of multiple measurements of anthropometrical and physical attributes were shown to be important for success within specific events:

> *It seems that if you are large and have aspirations as a track athlete you have (always in general) a choice of the 400m, 110m hurdles, 400m hurdles and 800m. If heavily muscled, that is built like a sprinter, 6 ft 2 in. and able to do 10.4 sec. for the 100m, then try the 400m. If a little slighter in muscle, and a little slower over the 100 m, then try the 800m, or else the 400 m hurdles. The ideal high hurdler should have long but powerful legs in relation to his body, powerful arms so that he can balance the leg clearance movements and by reaction speed up the legs in their drive forward, and the skier's sense of rhythm.* (Tanner, 1964: p.109)

In similar fashion, Tittel's (1965) research mathematically confirmed that multiple anthropometrical and physical measures were able to distinguish between athletes competing in different events in the Olympic games.

Kohlraush (1929, cited in Tanner, 1964), Correnti and Zauli (1964), Tanner (1964), and Tittel (1965) have all provided useful information on the profiles of Olympic athletes. However, these studies were limited, both in terms of the number of athletes analysed, and also because only male athletes were considered. In extending this early work, de Garay et al. (1974) looked at the physical and anthropometric profile of 1265 male and female athletes across 13 sports (129 separate events) in the 1968 Olympics in Mexico City. Measurements were compared with a control group of 370 non-athletes. de Garay et al.'s work (1974) confirmed and developed awareness of distinct anthropometrical and physical profiles for successful Olympic athletes in different sporting events.

Unfortunately, the comparatively close relationship that was established between an athlete's physical characteristics and their sporting event has resulted in the belief, held by both coaches and sport scientists, that profiling young children on anthropometrical and physical measures will enable the identification of individuals who have the potential to be successful in a specific event (Petiot, Salmela, &

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Hoshizaki, 1987). Thus, Grabiner and McKelvain (1987) stated, "the ability to identify young people whose profile is consistent with that of elite gymnasts may enhance the sport development of the individual by giving information about future success" (p.121). Consequently, talent detection and identification models largely have been underpinned by an analysis of the anthropometrical and physical characteristics of both successful senior and junior athletes within a specific sport (e.g., Talent Search). However, such models inevitably are limited since, (1) anthropometric and physical factors are unstable during adolescence, (2) determinants of performance have been found to vary with age, and (3) recent research into the anthropometrical differences of successful athletes in different sports has been inconclusive. Accordingly, the next section considers these features, and their implications for the efficacy of anthropometrical and physical talent detection and identification models.

2.2.1 Developmental Considerations

It is widely believed that any talent detection and identification model can only be successful if the characteristics measured are innate (Simonton, 1999), and this belief is reflected in the majority of existing schemes. This position acknowledges that mature levels of innate characteristics are predetermined and can only be influenced by extreme environmental conditions (e.g., malnutrition). Conversely, characteristics that are not innate are influenced continually by the environment and individuals' experiences. It is therefore unlikely that mature levels of these latter variables can be predicted. Thus, evaluation of innate factors as essential precursors of high-level performance represents an effective means of evaluating current talent detection and identification practice.

Physical Determinants of Performance

Whilst physical measures have been shown to distinguish between successful athletes in various sports, regular training is known to alter values of physical factors (e.g., strength and flexibility). For example, whilst arm extension strength is able to distinguish between mature swimmers and non-swimmers, differentiation increases further with maturity (Bloomfield, Blanksby, & Ackland, 1990). Since the shoulder joint provides the majority of propulsive force for all swimming strokes (Cureton, 1970; Pietter and Clarys, 1979), it is not surprising that flexibility improves with training. Crucially however, whilst it is accepted that shoulder flexibility can discriminate between mature swimmers and non-competitors (Bloomfield & Blanksby, 1971), Bloomfield et al. (1990) found no differences between the flexibility of adolescent swimmers and non-swimmers. Accordingly, they concluded that flexibility differentiation must occur after adolescence, presumably as a result of regular training, and not as a result of some performance precursor. In fact, weaknesses in certain areas can be remedied through appropriate training and also may be compensated for by strengths in other areas. Therefore, whilst physical profiling can generate a useful database against which talented players may be compared in order to tease out precursors of elitism, the use of such measures for identifying talents and "selecting out" individuals is questionable and arguably even unethical.

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Anthropometrical Determinants of Performance

Unlike physical measures, it is accepted that anthropometric values are innate. However, the inclusion of 'innate' anthropometrical parameters within talent detection and identification models is also problematic. Although pre-determined, the anthropometric growth patterns of individuals are known to be non-linear, and therefore, adult and adolescent values may not correlate. As an example, an adolescent who is taller than his or her peers may develop into a tall adult, but also may be average or below average height. This dynamic and non-sequential growth pattern of children is demonstrated in Figure 2.1. The implication is clear: "the identification of some positive characteristic in a pre-adolescent child ... does not guarantee that the characteristic will remain through-out the process of maturation toward the adult form" (Ackland and Bloomfield, 1996, p.57)
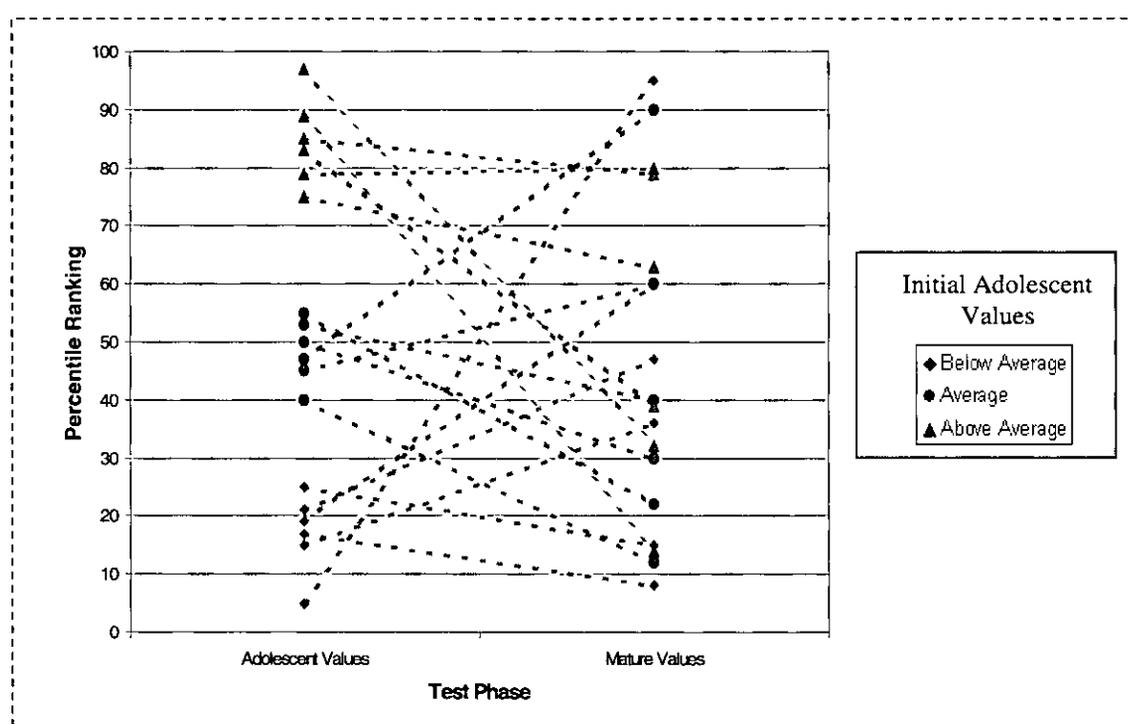
Figure 2.1: The Dynamic and Non-Sequential Growth Patterns of Adolescents (after Tanner, 1964)

Hence, the inclusion of any anthropometric variable within a talent detection and identification model would be problematic, unless inter-individual differences on that variable were maintained into adulthood. In a British Olympic Association report on TI and selection, Borms (1994) recognised the significance of the stability of a variable employed in talent detection and identification procedures. Borms defined stability as "the maintenance of relative rankings within the distribution among a group of peers over time" (p.8). Borms implied that characteristics that have a strong genetic determination are always stable. However, using our earlier example, although eventual height is largely predetermined, height is not relatively stable overtime. Unfortunately, the age at which mature levels of many anthropometrical factors can be forecast is undecided, as very little research has looked at the stability of the proportions of the growing child and the adolescent (Bloomfield, 1995; Borms, 1994).

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In fact, Ackland and Bloomfield (1996) did carry out a five-year research study into the stability of body segments within adolescents. It was found that differences between groups of adolescents on proportional breadth variables were sustained over the five years. However, many segment lengths either did not stabilise or did not stabilise until mid-adolescence. In the former case, initial differences between individuals for lower limb variables were not maintained. Ackland and Bloomfield's findings emphasise the inappropriateness of employing anthropometrical measurements, and in particular lower limb measurements, as early indicators of talent. Similarly, the prediction of adult somatotype from a child's known physique type at a young age is also difficult (Hebbelnick, Ross, Carter & Borms, 1980). Reviewing research on stability of physiques, Borms (1994) stated,

> *The extent to which the event of puberty modified an individual's prepubertal physique was never totally predictable. This posed a serious problem for those who were looking for ideal physique type among children of a tender age.* (p.11)

A further complexity in the search for determinants of excellence is that the stability of the same anthropometrical parameter differs between males and females (Malina & Bouchard, 1991; Hebbelnick et al., 1980).

2.2.2 Anthropometrical and Physical Determinants of Performance Vary with Age.

Research into the anthropometrical and physical profiles of athletes have found that the determinants of success vary at different age groups (e.g., Regnier & Salmela, 1987; Fleishman, 1972; Jancarik & Salmela, 1987). For example, Regnier and Salmela (1987) looked at determinants of performance in gymnasts between the age of 10 and 19, but found that not one physical and anthropometrical variable was among the five best determinants of performance across all age groups. This sort of evidence for age related determinants of performance has led researchers to call for talent detection and identification models that reflect these changes. Regnier and Salmela (1987) stated "separate analysis must be done on each age group in order to identify what group of variables best predicts success for that particular age group" (p.144). Similarly, Sol (1987) highlighted the need for longitudinal research to find predictive test items at various ages.

There is a further problem however. The underlying assumption supporting unique talent detection and identification models at different ages is that the individual who is performing the best at any one age group is the individual with the most talent. However, such an assumption is unfounded. For example, it has clearly been established that the adolescents who excel at strength sports (e.g., rugby, weight-lifting) tend to be early maturers (Bloomfield, 1995; Blanskby, 1980; Williams & Franks, 1998) whilst less mature adolescents tend to excel in coordination sports (e.g., rowing, gymnastics) (Shakespear, 1980, de Garay et al., 1974). Unfortunately, talent detection and identification models that do employ anthropometrical and physical variables will identify adolescents who dominate at the time of testing, as opposed to those who have the potential to excel. Additionally, changes in physique (e.g., height,

weight) following the growth spurt will influence control parameters which will lead to changes in actual and perceived physical competency.

What are the implications of a selection model that favours either early or late maturers?

Consider a selection policy that favours individuals who are able to overpower their less mature competitors through size and strength. For a late maturer to develop successfully along the athletic continuum, they would have to be technically superior just to 'hang in there' (Moore, Collins, Burwitz, & Jess, 1998). Those few late maturers who do persevere until they obtain mature physical levels are likely eventually to surpass the performance of the early maturers who have not been required to develop optimum technical skills, nor even perhaps develop and exhibit similarly high levels of work rate and determination! Additionally, once 'caught up' by these late developers, the early maturers often drop out, frustrated perhaps by their sudden inability to compete with the technically superior athletes and the lack of experience in working through difficulties.

In summary, two problems exist. Firstly, models that rely on anthropometrical determinants of talent, which initially favours early maturers, may be prematurely eliminating many athletes who have potential. Secondly, due to emphasising the importance of strength and size, evidence suggests that early maturers who do have talent are also disadvantaged by not being required to develop appropriate technical skills until it becomes too late. Similar criticisms can also be applied against selection policies that favour late maturers (e.g., gymnastics). Clearly, the distinction between 'performance' and 'talent' is crucial if talented athletes are going to be given optimal opportunities to develop.

2.2.3 Anthropometrical and Physical Measures are Not Always Consistent Performance Determinants.

Although initial research (e.g., Tanner, 1964) found that anthropometrical (e.g., height) and physiological (e.g., strength) measures are able to distinguish between successful athletes involved in different sporting events, recent research has failed to replicate this finding. Van der Walt (1988) and de Garay et al. (1974) found that whilst some sports were typified by certain anthropometric and physical profiles, distinct profiles were not established for all events. For example, de Garay et al. found that the anthropometrical and physical profiles of male rowers, cyclists, and swimmers were indistinguishable. It appears that determinants of excellence must go beyond the physique of the athlete. This inability of physiological and anthropometrical measures to classify an athlete's event has also been reported in gymnastics (Regnier and Salmela, 1987) and with Ultra-man competitors (Dettweiler, Daehne, & Loots, 1991). Further, the Training Of Young British Athletes (TOYA) study (Baxter-Jones & Helms, 1996) found no distinct profiles for successful adolescent male footballers, female swimmers and male and female gymnasts. These findings pose the question to what extent psychological factors play a decisive role in sporting success. Interestingly, within the TOYA study, the number of hours trained per week was found to be a better predictor of performance for both swimmers and gymnasts than physique.

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A possible explanation for these inconclusive findings?

The distinct profiles of successful athletes competing in different events can be largely attributed to the mechanics underpinning different events. Clearly, certain physiques are advantageous in some events but a disadvantage in other events (Tanner, 1964). For instance, in discus, the speed of the discus at the moment of release is of prime importance in determining how far it will go, and for a given angular velocity (dependent on how fast the thrower does his turn) the speed is proportional to the length of the 'lever' (the arm) throwing the discus. Therefore, long powerful arms will always be advantageous. In contrast, short arms are advantageous in weight-lifting since less force would need to be exerted by the muscles to lift the weight.

However, the extent to which physique can distinguish between athletes in different events may partly be dependent on the complexity of the event. For example, consider the dynamic environment experienced by players involved in team sports such as football or basketball:

> *Players are confronted with a complex and rapidly changing environment. Players must pick up information from the ball, team-mates and opponents before making an appropriate response based upon current objectives (e.g., strategy, tactics) and action constraints (e.g., technical ability, physical capacity). Such decisions are often made under pressure, with opponents trying to restrict 'time' and 'space' available to perform.*

> (Williams, 2000, p.737)

Contrast these demands with those of individual sports (e.g., track and field, rowing, cycling), where the environment is stable and predictable and there are discrete objective measures of performance. In support of the need to consider the complexity of events, de Garay et al. (1974) found that Olympic sprinters had distinctive physical profiles. In basketball however, even though height was considered advantageous and most players tended to be tall, relatively small players still had their place. Similarly, marked differences have been observed in the anthropometric and physiological characteristics of top football players (Reilly, 1990). Contrastingly however, Reilly, Williams, Nevill and Franks (2000) were able to distinguish between the performance of elite and sub-elite football players by using a combination of anthropometrical, physiological, psychological and soccer-specific skills.

Although, it has been highlighted that the contribution of physique to success is likely to be greater in closed skill sports, even here many examples exist of individuals who have excelled without the anthropometrical and physical profile perceived necessary to succeed. For example, Pietro Mennea held the 200m-world record for 17 years from 1979 to 1996. However, as a youth he was given little hope since it was believed that he did not have the required physique. Apparently, dedication and application were the key factors in his outstanding success.

Distinguishing between Performances of World-Class Athletes

Even if it is accepted that certain physiological and anthropometric factors can distinguish between athletes in different sports, they are unable to distinguish between performances of individuals at world-class level. In a typical study, Van Ingen Schenau, Koning, Bakker and De Groot (1996) looked at performance-influencing factors in homogeneous groups of top athletes, such as would be found in the final of major championships. They found that anthropometrical factors were unable to explain any variation in athletes' performances. Such a finding is consistent with the earlier research by Tanner (1964) who reported that direction of variation around the mean on determining attributes for Olympic athletes was not found to relate to performance. In the finals of major championships, physiques are likely to become matched and factors such as mental focus become all important (Rushall, 1989; McDonald, 1984).

A related failure of physiological and anthropometrical measures is their inability to discriminate between individuals who can and cannot maintain world-class levels of performances once obtained. It is apparent that the physique of an individual who excels at the world-class level on one occasion does not prohibit success: however, many athletes fail to maintain this standard. For example, Kreiner-Phillips and Orlick (1993) found that out of 17 athletes who had won major international titles in a range of sports, only seven continued to maintain their level of performance. The remaining athletes either experienced prolonged performance slumps (n=6) or were never able to reproduce comparative performances (n=4). Interestingly, Kreiner-Phillips and Orlick found that psychological factors were able to distinguish between these three groups.

Summary

Anthropometrical and physical parameters have been found to discriminate among successful athletes in different sports. However, work with preadolescent athletes (Bloomfield et al., 1985; Blanksby, Bloomfield, Ponchard and Ackland, 1990; Regnier & Salmela, 1987) has demonstrated clearly that the identification of talented performers is not possible by anthropometrical and physical measures before the adolescent growth period due to their instability. Talent detection and identification models that rely on anthropometrical and physical measures would only work if the measurement of the key variables occurred once it was known that their relative values between individuals were stable. Gender differences in the onset of peak values would also need to be acknowledged (Malina & Bouchard, 1991). Unfortunately, such models would be problematic to develop since the stability of many factors (e.g., posture, flexibility, and speed), which are accepted as being important to success in various sporting events, have not been studied in a systematic way (Bloomfield, 1995). Further, the delayed identification of individuals into sport would likely be resisted due to the clear correlation that has been established between the number of years of deliberate practice and success (Ericsson et al., 1993). Additionally, whilst anthropometrical and physical talent detection and identification models measure determinants of performance rather than potential, recent research has questioned the ability of physiological and anthropometrical factors to distinguish among athletes in different events. It may be that physique is more influential in closed sports (stable environment). However, in open sports, other factors, such as decision-making decrease the significance of an individual's physique. Further,

physique is unable to distinguish between performances within finals of major championships. The bottom line is that the present exclusive or predominant emphasis of innate, nature-driven factors in talent detection and identification processes appears unfounded.

2.3 NATURE AND NURTURE: Fundamental Movement Skills

Participation in sport and physical education requires individuals to perform an array of different movements. Many of these movements are complex, specialised skills used in specific physical activities (e.g., top slice in tennis or the spike in volleyball). However, the majority of these specialised movements are underpinned by common skills (e.g., running, jumping, throwing). For instance, to be successful at triple jump, an individual must be able to run, jump, hop, leap, and land. These basic movements, which are common to a range of activities, are known as fundamental motor abilities and are defined as:

> *A general template for a movement. The template becomes the basis of a number of specific skills, for example ... an underarm throw is a movement pattern and bowling in rounders is a specific skill that develops from it.*

> (DES, 1991, p.26)

Fundamental motor abilities can be divided into three broad categories: travelling, object control and balance (see Table 2.2).

The development of these basic movement skills are seen as the 'building blocks' for future successful performance and involvement in more specialised games, sports, dance and recreational activities (Armstrong, 1990; DES, 1991; Sports Council, 1993; Jess, Collins & Burwitz, 1998). The importance of developing these basic movements was emphasised by Seefeldt, Haubensricke and Reuchslein (1979) who stated that:

> *Children who possess inadequate motor skills are often relegated to a life of exclusion from organised and free play experiences of their peers, and subsequently, to a lifetime of inactivity because of their frustration in early movement behaviour.*

Consequently, fundamental motor abilities are seen as essential precursors to excellence in sport (Moore et al., 1998; Jess et al., 1998). In a survey of elite English sports performers, Moore et al. identified that coaches believed that unless a child had developed the fundamental movement skills required within an activity by twelve or thirteen, success within that activity would be beyond reach.

Table 2.2: Fundamental Motor Abilities (adapted from Jess, 1999)

Travelling Skills	Object Control Skills	Balance Movements
Walking	*Sending:*	Ready position
Running	Throwing	Balance/ Stillness
Jumping	Kicking	Stop
Hopping	Punting	Land
Leaping	Ball Rolling	Sink/fall
Sliding	Ball Strike	Swing
Galloping	*Receive:*	Stretch/curl
Climbing	Catching	Twist/turn
Swinging	Trapping (feet)	Spin
Skipping	Stopping (stick)	Body roll
	Travel With:	Dodge
	Dribbling (hands)	
	Dribbling (feet)	
	Dribbling (stick)	
	Receive and Send:	
	Volleying	
	Striking (bat)	
	Striking (stick)	

Further, coaches reported that a broad base of fundamental motor abilities characterized children with high potential:

> *You can see the girl who has been to dance or gymnastics. Her balance is already well developed and she can move on quite quickly, whereas some other kids need to learn how to land on one foot without falling over.*

(Moore et al., 1998)

Generally it has been believed that these abilities are inherent and that children will develop them naturally by the age of seven if given the opportunity to explore different ways of moving. However, it is now recognised that these fundamental motor abilities do not develop automatically (Gallahue, 1982; Jess, 1999) but rather, that well-coordinated production of these movements will only occur with quality teaching and regular opportunities to practise. Schmidt (1982) within his theories of learning also acknowledges the influence of prior experience, learning and socialisation in sport on movement ability.

Unfortunately, recent investigations from different parts of the world suggest that most young children do not receive appropriate movement opportunities (e.g., Reuchslein & Vogel, 1985; Ross, Dotson, Gilbert, & Kitz, 1985). Within the Development of Talent Study (DOTS, Moore, Collins, Burwitz & Jess, 1998), it was found that coaches and teachers believed that children were 'movement illiterate' due to not having the opportunities to develop adequate levels of basic motor abilities.

Consequently, whilst anecdotal and research evidence supports that fundamental motor abilities are essential to sporting success, it does not appear that children are currently being provided with appropriate movement experiences. Unfortunately, the monitoring of fundamental motor abilities within TDI programmes, will likely lead to those individuals who have had relevant experiences being selected, as opposed to children with talent potential. Therefore, talent detection and identification schemes need to be preceded by a fundamental motor abilities programme that is available to all.

Early specialisation of youngsters

In the UK, recent government initiatives (e.g., Sport: Raising the Game, DNH, 1996; Young and Active?, HEA, 1997) are increasingly influencing physical activity development throughout the childhood years. However, these schemes encourage early specialisation in sports (e.g., mini-sport) with the result that children are exposed to sport specific basic skills rather than generic motor abilities. In terms of participation, many individuals drop out of sport and are likely to discontinue sport altogether if they do not have, or perceive that they do not have, the skills required to participate in an alternative activity. Furthermore, early specialisation will lead to any immature fundamental motor patterns being carried forward and, at least temporarily, becoming part of an individual's pattern used in performing a sports skill (Harrison, Watkins & Farrally, 1983). Additionally, since successful athletes often excel in a sport other than the one they are involved in initially (Moore et al., 1998), individuals need to develop a broad base of motor abilities to transfer successfully from one sport to another.

In summary, generic motor patterns underpin all sports and it is important that children develop these skills if they are going to excel, or indeed participate. Any talent detection and identification programme needs to be preceded by movement opportunities to develop these key attributes. However, children do not currently appear to be provided with these opportunities. Conversely, TID comes about through luck in terms of chance involvement in specific sport activities and a process of early selection within a club setting. However, it is unlikely that such a sport specific system of TID could effectively support children who are selected initially and then drop out, or identify individuals with potential talent but who have not had relevant movement experiences.

2.4 NURTURE vs. NATURE: Psychological Determinants of Excellence

In the quest for information on factors associated with high-level athletic success, researchers have paid considerable attention to the psychological characteristics associated with elite athletic performance. Recent research across a variety of

achievement settings has established mental characteristics as crucial to, or even causative of, elite performance (McCaffery & Orlick, 1989; Moore et al., 1998). However, although current TID models are based on distinctions between elite and non-elite athletes, limited emphasis is given to mental attributes.

Performance Determinants

Research consistently has identified psychological determinants of sporting performance. McCaffrey and Orlick (1989) found that top touring professional golfers could be distinguished from lesser skilled club professionals on a number of psychological factors. Orlick and Partington (1988) also found a number of common 'elements of excellence' for elite Canadian athletes. Similarly, an investigation by Gould and colleagues (Gould, Jackson, & Finch, 1993a; Gould, Jackson, & Finch, 1993b; Gould, Finch, & Jackson, 1993c), of Olympic medallists and non-medallists in the 1988 Olympic Games, found that significant psychological distinctions were apparent, relating to mental preparation and precompetitive cognition and affect (Gould et al., 1993a), competitive cognition and affect (Gould et al., 1993b) and coping strategies (Gould et al., 1993). In another study, Silva, Shultz, Haslam, Martin and Murray (1985) assessed determinants of qualifiers and non-qualifiers in the 1980 United States Olympic wrestling trials. Psychological variables were able to discriminate between groups with 78.1% accuracy. Interestingly, physiological variables were less important and only able to discriminate between performances with 60.9% accuracy. Similarly, Orlick and Partington (1988) showed that in terms of physical, technical, and mental preparation of Canadian Olympians, only the latter variable could significantly predict actual Olympic placing.

As a result of work conducted by Orlick and his colleagues across a range of events (Orlick, Hansen, Reed, & O'Hara, 1978; Orlick & Partington, 1988; McCaffrey & Orlick, 1989; Talbot-Honeck & Orlick, 1998) a combination of pre-event and in-event behaviours are now accepted as being able to distinguish between performances of elite and sub-elite class athletes (see Figure 2.2). Borms (1994), in a British Olympic Association report on TI and selection, highlighted the role of 'behavioural dispositions' in sporting performance. Consequently, it would seem crucial that any TID model considers these psychological characteristics of excellence. Thomson (1992) in a Scottish Sports Council report on 'giftedness and excellence in sport', highlighted psychological factors as important determinants of whether potential can be translated into performance. Similarly, Kane (1986) stated, "the ultimate factors accounting for achievement are likely to be the unique personal and behavioural dispositions which the individual brings to the actual performance" (p.191). Unfortunately however, emphasis on psychological development within British sport remains minimal (Abbott & Collins, 1998).

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Commitment
Quality Practice
Goal Setting
Imagery
Planning at all levels
Distraction control strategies
Perceptions of pressure
Performance evaluation
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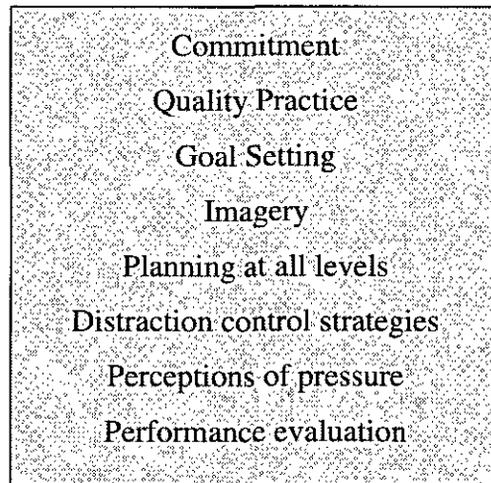
Figure 2.2: Psychological Determinants of Excellence

'Getting There' and 'Staying There'

The ability to produce consistently world-class performances is often viewed as the mark of a true champion. In this regard however, both Jackson, Mayocchi, and Dover (1998) and Kreiner-Phillips and Orlick (1993) reported that elite athletes have difficulty maintaining levels of success. The British Amateur Athletic Association reported that in the 1976 Montreal Olympics, 70% of athletes failed to produce par performances (McNab, 1981). In the British setting, the increasing need for consistent success, in order to retain crucial financial support, makes this a pertinent topic for talent-related research. Although considerable attention has been paid to the psychological factors associated with elite athletic performance, only recently has research begun to look at the determining factors of continued athletic success. For example, Gould, Jackson and Finch (1993) found that figure skaters defending a national championship experienced increased expectation and responsibility, and a shifted motivational orientation involving a dislike for "being chased". Kreiner-Phillips and Orlick (1993) also found that increased personal and external expectations experienced by athletes affected performance. Additionally, the ability of athletes to retain a best-performance focus in subsequent competitions was key to continued success. These psychological determinants of continued success emphasise the importance of some developmental efforts being allocated to 'maintenance skills', a further consideration for inclusion in TID schemes.

Skill Acquisition Determinants

The development of effective TID processes is also dependent on the distinction between factors that typify world-class performances, and factors that characterise successful skills acquisition. It is not unusual for youngsters to appear with the former but without the latter. Reports are common of coaches' exasperation with young performers who, whilst apparently possessing all the necessary physical attributes to make it, fail to come through or even drop out through a lack of the right mental approach to skill development (Hemery, 1986). A variety of psychological factors would appear to characterise athletes who have the potential to acquire and consolidate skills. Kunst and Florescu (1971) highlighted the different importance of psychological capacity, motor capacity and biometric qualities to determinants of

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performance and determinants of talent in wrestling (see Figure 2.3). Whilst motor capacity was considered the most important factor for performance, psychological factors were considered most important for talent detection and identification.
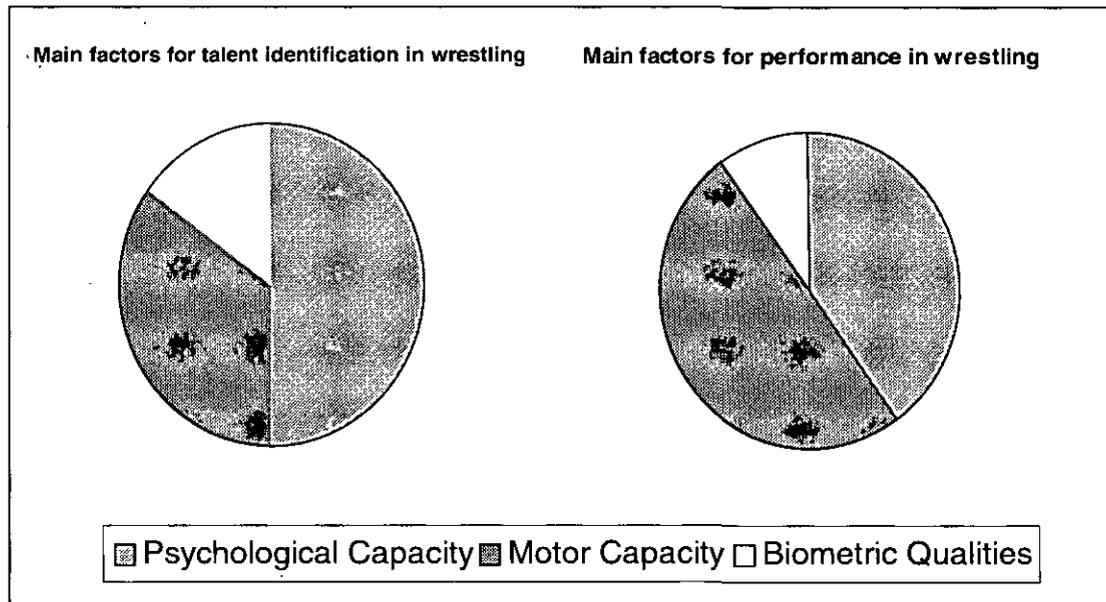
Figure 2.3: Relative importance of psychological, motor and biometric factors in talent identification and performance in wrestling (adapted from Kunst and Florescu, 1971)

Bompa (1999) also believes that psychological capacity is the most important factor in talent detection and identification, although once again specifically in wrestling:

> *In talent identification, it is more important for someone uninitiated to wrestling to possess the main psychological traits and the desire to wrestle, because you cannot expect a beginner to have developed the motor capacity.*

(Bompa, 1999, p.286)

Thomson (1992, Scottish Sports Council report) recognised that in addition to the problem of how to develop excellence, there is an equally important question of how to retain talented performers in sport. A TID model that acknowledges the psychological characteristics of excellence presented in Figure 2.2 would not only aid skill acquisition and performance, but would also establish characteristics that would promote motivation (e.g., commitment, goal setting and performance evaluation).

Clearly, whilst TID systems need to consider determinants of performance, resources also need to be targeted towards determinants of the ability successfully to acquire and consolidate skills. Of course, it is important to recognise that athletes who do not have such developmental potential may still score highly on many performance determinants. For example, within Talent Search, an individual who has a lack of capacity to improve may still score highly on the anthropometrical and physical measures. Interestingly for the present context, those adolescents who successfully persevere within a sport, although their maturity status puts them at a performance disadvantage, are likely to have progressed due to factors such as motivation and mental toughness.

2.5 Summary of Research on Talent Detection and Identification Models

It has been established that the aim of talent detection and identification is to provide an accurate prediction of those individuals who have the potential to compete successfully at world-class levels. Such talent detection and identification procedures tend to be employed with pre-pubescent or pubescent children so that selected children can complete the number of years practice which has been demonstrated as required to achieve excellence (Ericsson et al., 1993). However, the necessity of identifying children during their pubescent years confounds the criteria that are used to predict performance potential. If talent detection and identification models based on the performance determinants of senior elite athletes are going to be successful, the performance determinants employed must be static variables at the time of testing. Unfortunately for this requirement, research has shown clearly that the anthropometrical and physiological factors that are able to discriminate between elite and sub-elite athletes are unstable during adolescence. Therefore, determinants of talent and the potential to acquire skills and determinants of performance need to be distinguished.

In order for individuals successfully to acquire sporting skills, it is important that they are equipped with the fundamental motor abilities (e.g., catch, kick, run) that underpin participation in their chosen sport. In terms of both participation and excellence there is a need for all children to be provided with appropriate movement experiences at a young age. Fundamental motor abilities should be developed prior to any sport specialisation so that individuals are able to transfer confidently among sports. Interestingly, those individuals who excel within sport often do so within a sport different from the one in which initially they were involved (Moore et al., 1998).

Whilst motor abilities underpin skill acquisition, psychological factors appear to be the main determinants of individuals' potential within sport. Not only will the psychological characteristics and behaviours of individuals determine if they are able to develop the required skills, but they also will influence whether an individual is able to stay committed to the necessary training so as to develop successfully within a sport and perform at the world class level. Additionally, psychological factors appear to be key to the ability of an individual to perform consistently once they have achieved world-class status. Unfortunately however, current talent detection and identification models place minimal emphasis on these key psychological and behavioural determinants.

SECTION 3: CONCEPTUAL MODELS OF TALENT DETECTION AND IDENTIFICATION

The previous section considered past research approaches that have influenced the design of talent detection and identification models. The next step is to examine the models that have emerged from this literature base. Accordingly, the following section will review and critically analyse conceptual models of talent detection and identification. Specifically, these models are designed to identify the presumed underlying determinants of potential and to search for those determinants within a population of potential athletes.

3.1 A Review of Conceptual Models of Talent Detection and Identification

Whilst a variety of approaches have been used, Harre (1982, cited in Regnier, Salmela and Russell, 1993) produced what has been described as "probably one of the most complete talent detection models in the literature" (Regnier et al., 1993, p.298). This model proposes that individuals are initially identified based on objective tests of ability (height, running speed, endurance, coordination, ability in game situations and 'athletic versatility'), building on the premise that detection should be based on performance determinants at the top level of competition. Within Section 2 however, it was clearly established that there is a need to distinguish between determinants of performance and determinants of potential/ skill acquisition. Additionally, the model only considers innate determinants of performance, whilst many key variables at this level would appear to depend as much on "environment as on heredity" (Regnier et al., 1993, p.298).

Positive features proposed by Harre's model (1982, cited in Regnier et al, 1993) include the recognition of the biological development of an individual. However, means of accounting for variable biological development rates are not highlighted. More pertinently for the purpose of this review, Harre also highlights the relevance of psychological and social variables, including attitude toward sports in school, participation in extra-curricular sports activities, and the personality development of the ideal "young socialist". Unfortunately, further details on these attributes are not provided. The model also highlights 'potential for improvement', which is measured by reaction to training programmes before selection to stage two of the model. Once again this would appear to be related to psychosocial factors.

In attempting a more comprehensive approach, Havlicek, Komadel, Komarik, and Simkova (1982, cited in Reginer et al, 1993) present a model that recognises the multi-dimensional nature of sports performance. Unfortunately, and once again, this model does not distinguish between potential and performance. More positively, whilst the role of innate predictors of talent is highlighted, Havlicek et al. recognise that factors that are influenced by the environment also can have significant influence on talent, although the research differentiation between these components is based largely on their stability. The researchers highlight that innate factors such as height are most important, followed by factors that are trainable but genetically influenced (e.g., speed), and finally factors that can be nurtured (e.g., motivation). In the current context, these suggestions again must be considered in the light of the arguments presented in the previous section.

Gimbel (1976, cited in Reginer et al, 1993) also highlights multiple determinants of talent. These include physiological and morphological factors, trainability, and motivation; all of which may underlie performance within a range of sports. Again, this model fails to distinguish between performance and potential. As a positive feature, Gimbel's model emphasises the need for prolonged deliberate practice, and consequently advocates that individuals must be identified at 8 to 9 years of age. However, it has clearly been established that adult levels of physiological and morphological factors (the main emphasis of his model) cannot be predicted during early childhood and, consequently Gimbel proposes a 'recovery period' where uncertain cases are supported for one year. Here things start to fall down, since those individuals selected at any stage will be identified based on determinants of performance rather than potential. Indeed, Gimbel himself recognises that it is impossible to predict talent from such tests because of biological age differences between children; an acknowledgement which, whilst at odds with his actual proposals, offers tacit support for consideration of determinants of potential as opposed to determinants of performance. Positively, Gimbel does recognise the importance of psychological variables and highlights how these variables have been neglected in predictive models. Accordingly, he advocates identifying the psychological factors underlying performance. However, once again no distinctions are made between these determinants and determinants of skill acquisition.

Montpetit and Cazorla (1982, cited in Reginer et al, 1993) expanded Gimbel's model (1976, cited in Reginer et al, 1993) to include details on the identification of morphological and physiological determinants of performance. They suggested that, initially, profiles of elite athletes based upon conventional physiological testing procedures are determined. The stability of these variables then should be verified through longitudinal testing, and only then may variables be applied to younger populations. A similar suggestion emerged from Bompa (1985), who developed a conceptual model of talent detection based on the system then commonly employed within the Eastern European countries. His model emphasises three types of performance determinants, namely: (1) motor capacities (perceptual and motor skills, endurance, strength, and power), (2) physiological capacities, and (3) morphological attributes. Detection is based on the direct comparison of physiological and morphological profiles from younger performers to those of elite athletes. As before, both models are based on the belief that determinants of performance and potential are synonymous.

Of interest is the basis on which Geron (1978) produced his model of talent detection. Whilst similarly based on identifying the elite athlete profile, Geron's model recognises the need to distinguish between the characteristics of a champion and the qualities required for an individual to become a champion. He also acknowledges that the profiling of individuals on innate determinants should only be completed at the age by which the factors have been established to be at their peak. Clearly however, many of the qualities required for an individual to become a champion are not innate, and once again, inconsistencies are apparent between the model and the tenets offered for its basis.

In contrast to the somewhat consistent pattern of the earlier work, Simonton (1999) provided a unique contribution to conceptual models of talent detection and

identification. Like previous conceptual models, this approach highlights the multi-dimensional nature of talent and recognises physical, physiological, cognitive and dispositional components. However, the model, which is based on both longitudinal and cross sectional research, has a number of features that have been overlooked previously. Importantly, and uniquely, Simonton's model distinguishes between determinants of performance and determinants of skill acquisition. Whilst the former will have significance in terms of an individual's capacity to be successful within a competitive environment, the latter are important if an individual is going to have the ability to learn relevant skills. For example, research within music and sport has demonstrated how talented individuals appear to be able to learn skills at a faster rate than the less talented. Of course, this increased rate of learning can be explained by innate intellectual ability. Alternatively however, dispositional attributes "such as unusual energy and special interests" that optimise intensity and focus could be responsible (Simonton, 1999, p.436). In addressing this question, and its importance for the effective design of TID, Simonton recognises that differences in levels of excellence can only be partly attributed to innate factors. Therefore, the influence of the environment during development is considered crucial:

> *It is extremely likely that the environmental factors, including deliberate practice, account for far more variance in performance than does innate capacity in every salient talent domain.*
> (Simonton, 1999, p.454).

The influence of the environment largely has been overlooked both within previous conceptual models and research within talent. However, within Simonton's model, both individual differences (somewhat confusingly termed emergenic factors) and how these individual differences develop across the formative years of a person's life (epigenetic) are considered.

The formulation of Simonton's model is based on the notion that there are a number of components which can contribute to the existence of talent within any domain, and that these factors interact in a multiplicative rather than an additive manner. This multiplicative model of talent has major implications for comprehending individual differences in talent and how these develop over time.

3.2 Implications of a Multiplicative Model of Talent and Individual Differences

In considering the multiplicative basis of interaction between factors Simonton (1999) offers four direct implications for TID:

1. The domain in which an individual displays talent will not be determined by any highly specialized component but rather by "the specific weighted multiplicative integration of the contributing innate components" (Simonton, 1999, p.438).

2. Individuals talented within the same domain will all have some value of each necessary component, since a multiplicative model implies that absence of any component will mean no talent. However, individuals' values on these components will vary. Consequently, there are an infinite number of formulae for talent within any domain.

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3. Exceptional talent within any domain will be extremely rare. Firstly, many individuals will have no talent due to the absence of one of the components. Secondly, whilst the incidence of any component will be normally distributed, their product within a multiplicative model will not be.
4. The number of innate components essential for performance will vary from domain to domain. Some domains will be complex with a large number of essential components; for instance, contrast closed and open sports.

A number of considerations for TID can be inferred from the emergenic model. Firstly, an individual who scores highly on any one particular component will not necessarily have talent since actual progress and attainment will depend upon the multiplicative profile of all the components essential to excellence within the domain. For example, if someone displays a high level of speed, their potential within a sport also will depend upon the other determinants of success, such as power, determination and coping skills. Additionally, children can display disparate scores on the determinants but be equally talented. Consequently, this model implies that predictability of talent is low if component scores rather than multiplicative effects are considered. Additionally, research that attempts to correlate success in a domain with individual components will be unsuccessful since those who excel inevitably will display a range of levels on each component.

The clear implication of Simonton's model (1999) is that an over-emphasis on uni-dimensional consideration of individual differences is doomed to failure:

> "The individual-differences model, for all its potential utility, remains too simplistic. The central deficiency is its static nature. .... The static conception of talent is plainly wrong. Talent development must instead entail some form of epigenesis. That is, starting with a relatively undifferentiated state, the various traits slowly appear and differentiate over time. ... Infancy, adolescence, and even adulthood will see the latent components undergoing various transformations".
>
> (Simonton, 1999, p.442)

This unique recognition of the model, namely that component values change with maturation, helps explain a number of phenomena observed in talented individuals.

Firstly, late and early bloomers will be evident within any talent domain. The early bloomer will be the individual who has adequate values of all components of talent at an early age. However, late developers may still possess the full range of necessary characteristics, but have one or more components that do not begin development until much later:

> Just because a trait claims a genetic foundation does not automatically mean that the trait appears all at once. On the contrary, many characteristics, even if under demonstrably genetic control, take many years, even decades, to emerge.
>
> (Simonton, 1999, p.449)

Once again, the need to distinguish between determinants of talent and determinants of potential is apparent. For example, an individual may excel in rugby at an early age

due to their size and strength, but this does not mean that they have developed the components of talent early. Rather, they possess a surreptitious set of components, which happen to suit them, for that particular sport at that particular time.

Additionally, the epigenetic part of Simonton's model (1999) also explains why it is difficult to identify early signs of talent. If a child does not display a component, this is maybe because the component is absent or because it will not develop until later. Due to the late emergence of components, as age increases, the number (and accuracy) of identified 'potentially talented' individuals will increase. Clearly therefore, the earlier a talent detection and identification procedure is employed, the more potentially talented individuals will be eliminated.

The epigenetic part of Simonton's model (1999) also can account for those individuals who show promise but never realise their potential. This loss of talent can be due to a relatively slower rate of increase in the multiplicative value of the required components of talent. Alternatively, however, it can be accounted for by an absolute loss in the value of the potential talent (e.g., as a result of injury). Additionally, since the components within a domain may be the same as those required in another domain, as individual differences develop, the athlete may become better suited to a domain other than the one they were originally involved in. This domain change by individuals has been identified already as an important component within British sport (Moore et al., 1998).

Finally, Simonton's epigenetic model (1999) highlights the difficulty of predicting talent. Due to its dynamic nature, "not only may the composition of a given talent change as a person ages, but the optimal talent domain may change as well" (Simonton, 1999, p.445). Consequently, it would appear to be of greater value to identify the determinants of skill acquisition and development, and help those individuals "equipped to progress" within sport to develop the necessary attributes for success.

3.3 Summary

The limitations of the majority of current conceptual models of talent detection and identification are apparent; specifically, these models are formulated primarily on presumed determinants of performance as opposed to talent. Additionally, those factors emphasised within these models tend to be 'innate' rather than 'develop-able' performance determinants. However, whilst talent is partly innate, an individual's development is largely dependent upon the environment, and the ways in which the individual interacts with it. Unfortunately, whilst many of the models do highlight psychological factors, primary emphasis is placed upon physiological and morphological determinants of performance, even though eventual adult levels of these variables are hard to predict from childhood measurements. Further, conceptual models have not recognised the importance of identifying how an individual actualises their talent within the competitive environment and maintains success once it has been achieved. An exception is the model proposed by Simonton (1999), which, uniquely, does distinguish between determinants of performance and skill acquisition. Recognition of the influence of the environment on innate components of talent and the multiplicative influence of these components provides a unique contribution to the area of talent detection and identification and accounts for a

number of phenomena that are observed within sport and non-sport domains (e.g., late developers, the apparent loss of talent). Accordingly, one would hope to see these principles at work in the most effective TID schemes. The next section will enable this judgement through a focus on the actual schemes currently in use around the world.

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SECTION 4: CURRENT PRACTICES IN TALENT DETECTION AND IDENTIFICATION

The aim of this section will be to review the efficacy of current talent detection and identification models employed in sport, both in Britain and worldwide.

4.1 Talent Detection and Identification Procedures in Sport

In recent years, many National Governing Bodies of Sport (NGBs) have initiated developmentally oriented programmes that identify then retain performers for an extended period. Although there have been some attempts in the past at talent detection (e.g., the Test and County Cricket Board's search for fast bowlers), the selection of individuals into these squads typically occurs from the current participation base. Within the BOA report into TI and selection, Rowley (1994) highlighted how 85% of football coaches, 67% of tennis coaches, 77% of swimming coaches and 48% of gymnastic coaches reported not employing any screening devices when identifying talent. This comparative lack of talent detection models within British sport has been attributed both to lack of resources and expertise to implement such programmes (DOTS, Moore et al., 1998).

4.1.1 Natural Selection

Whilst NGBs recognise the importance of talent detection and identification, very few have employed systematic approaches (DOTS, Moore et al., 1998; McNab, 1981). Currently, the principle approach employed by NGBs is a natural TI process based on subjective assessment and performance (Burwitz, Moore & Wilkinson, 1994). For instance, tennis selects young people almost exclusively on the basis of a performance-based 'handicap', with success achievable only by participation in geographically dispersed and 'pay-as-you-enter' tournaments. Minimal testing or development occurs outside this performance focus. In similar fashion, swimming, as represented by the Elite 2000 programme, is exclusively performance-oriented, with progression dependent on times achieved. Thus, for most NGBs, talent detection and identification can often equate to selection of the young players who are able to perform the best at the time of testing as opposed to the selection of those with potential. Unfortunately, for the veracity and efficacy of this procedure, as highlighted in Section 2, adolescents that excel at strength sports (e.g., rugby) tend to be early maturers and those that excel within co-ordination sports (e.g., rowing) late maturers.

Analysis of the birth dates of individuals within British youth development squads provides evidence that physical maturity is indeed a determining factor in the selection of athletes. Baxter-Jones and Helms (1996) reported that over 50% of footballers, swimmers and tennis players selected into English youth squads were born within the first 3 months of the selection year. Richardson and Stratton (1999) analysed the birth-dates of the England World Cup squads for the 1982 to 1998 campaigns. They reported that over 50% of players selected were born early in the competition year (September and December). These findings suggest an inevitable bias because of selection policies at youth level that favour individuals that are more physically mature. Whilst both the football association and lawn tennis association schools of sport have reported a high level of success at the junior level (Thomson, 1992, Scottish Sports Council report), limited success has resulted at the senior level.

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Since players are being selected on performance at the junior level, success at that level is not surprising. However, the key question is whether these juniors have the potential to achieve at the senior level. Unfortunately, the characteristics required to develop into a successful senior athlete are not identified in either the football or the tennis TI procedures. Reinforcing the tendency of British children to be selected due to performance at the junior level, Rowley (1994, BOA report) discussed research that found that British children whose birth dates fell within the first half of the selection year were more likely to be identified as talented. Interestingly, Baxter-Jones and Helms found that, within female gymnastics, where short-levers are advantageous, British adolescents selected into development squads tended, by contrast, to be late maturers.

Of course, if physique is important for performance, then why not identify athletes on anthropometrical and physical performance determinants? Such talent detection and identification procedures are problematic however since, as highlighted within Section 2, relative sizes between individuals do not remain stable into adulthood. Interestingly, whilst British female gymnasts were found to be below average height from 12 to 16 years, at 17 years they tended to be similar in height to the average population (Baxter-Jones & Helms, 1996). Therefore, if short levers were a prerequisite to success in gymnastics, individuals identified through current selection policies are unlikely to excel at 17 years and beyond. Whilst it is recognised that female gymnastics was a relatively young-focused activity, senior levels of competition for most sports do not begin until an individual has reached 17 years. Thus, the problems of early identification failing to predict eventual size will be even more exacerbated.

As a further problem, the performance–oriented models widely employed by British NGBs, do not recognise the role of psychological factors in the development of sporting excellence. As highlighted in Section 2, psychological factors appear to be major determinants of whether an individual is able successfully to acquire skills and progress along the athletic continuum (Kunst & Florescu, 1971). Also, as players improve and greater technical and physical homogeneity is achieved, psychological factors (decision making, imagery use, etc.) will become increasingly more important to performance. This is especially true in those sports that require an individual to perform within an unstable and unpredictable environment. Further, the ability of an individual to perform consistently at world-class level is largely dependent upon psychological factors.

Clearly, the distinction between 'performance' and 'talent' is an important one, but a difference that does not appear to have been grasped fully by British funding agencies or NGBs. Indeed, both may have to recognise that to achieve excellence at the world-class level, they may have to forego excellence at the junior levels since the individuals who will excel at the two levels may be different. That is, the determinants of performance and the determinants of potential during adolescence are likely to be disparate. It may be for this very reason that, despite only losing on penalties in the U16 World Football Cup final in 1989, Scotland has failed to exploit this success as a basis for subsequent performance in the adult game. Thus, whilst British talent detection and identification models have been based almost exclusively on the existence of current skills and ability, together with a less evident focus on innate early indicators of talent, procedures need to evolve so that coaches can work with

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individuals of high potential on those factors that will have a direct impact on performance at senior level.

4.1.2 Anthropometrical and Physiological Talent Detection and Identification Models

Recently, England, Ireland, and Scotland have introduced a model based on the Australian Sport Search/ Talent Search programme, which measures adolescents on certain anthropometrical, physiological and performance tasks. Within Scotland, the model, 'Sport Interactive', was employed as both a tool to increase participation levels across a range of sports, and as a talent detection tool. As the main focus of this research, the efficacy of Talent Search and Sport Interactive will be reviewed later in this Section.

4.1.3 Generic Models

As highlighted within Section 2, successful participation in sport requires an array of different movements. Whilst many of these movements are specific to different sports, others are common to a range of activities, (e.g., catching). These common movements are called fundamental motor abilities.

Recently, a TID model has been developed and piloted within England that emphasises the importance of individuals developing mature levels of fundamental motor abilities if they are to become involved and maintain involvement within sport (Jess, 1999). Innovatively, this model has ensured that children are provided with appropriate learning experiences prior to the selection of any potential talent.

The model provides all children in year 3 and 4 in primary school (age 7-9) with the opportunity to attend a generic activities club. Within this club, fundamental movement abilities (e.g., kick, catch, leap), as opposed to sport specific skills (e.g., football), are developed. Following a 10-week block, selection of potential talent occurs. Selection is based on the ability of the children across the range of fundamental movements. Those children selected are invited to attend a class where application of these fundamental abilities within the context of activities and games is pursued.

The programme is still in its early stages but following the first year of delivery appears to be very promising with children of all levels of ability opting for involvement. Further research is required to establish whether children who would previously have been overlooked, due to poor fundamental movement skills, are being identified into the advanced class. Interestingly, this model is running parallel to a traditional early sport-specialisation model in tennis. The impact of the different models on children's involvement and performance in sport is currently been assessed through longitudinal research, which will be completed by January 2003.

4.2 Non-British Talent Detection and Identification Procedures

Communist nations have experienced considerable success in sport on the international arena; for example consider the performance of the USSR, GDR and Cuba within the Olympic Games (see Table 4.1). In 1988, the Soviet Union

dominated the twenty-three sports in the summer Olympics and the twelve sports in the winter Olympics. As a consequence of this success, some in the West have looked with envy at the talent detection and nurturing systems employed in the Communist nations (Riordan, 1993). Unfortunately, a thorough analysis of the talent detection and identification procedures is hindered due both to limited information available on the specific criterion, and some 'strong conjecture' as to the ethics of the procedures employed! Nevertheless, a review of talent detection and identification procedures that are documented within the literature follows.

Table 4.1: Olympic Medal Table position of Cuba, USSR and GDR/ Germany from the 1960 to 2000 Olympics

	Olympic Games Year										
Country	1960	1964	1968	1972	1976	1980	1984	1988	1992	1996	2000
	Position in Medal Table										
Cuba	53rd	32nd	31st	15th	8th	4th	-	-	5th	8th	10th
USSR	1st	2nd	2nd	1st	1st	1st	-	1st	1st	2nd	2nd
GDR/ Ger*	10th	11th	5th	3rd	2nd	2nd	3rd	2nd	3rd*	3rd*	5th*

* Competed as Germany following unification

4.2.1 Performance Models

Although there evidently has been an increased recognition worldwide of the value of employing effective talent detection processes, it is apparent that athletes around the world are commonly selected into a range of sports by 'natural selection' methods. For example, the screening criterion applied most frequently in Germany, Canada, the USSR, Sweden and Brazil, for selection into development squads and sport schools, is competition results (Ferreira, 1986; Kozel, 1996; Riordan, 1990; Thomson, 1992). Once here, athletes continue only if they can 'produce the goods'. This school of hard knocks approach obviously can bring success, as the performances highlighted in Table 4.1 clearly show. In less 'demanding' regimes however, several down-sides to this process can be seen. In Canada for example, Valeriote and Hansen (1986) highlight how the over-emphasis at all age levels on winning is thought to contribute to the high dropout rate from competitive programmes. Unfortunately however, the success of a country in sport is often inappropriately attributed to their talent detection and identification methods. For example, due to Malaysia's success in badminton, the 'atheoretical' performance based TI models they employ are perceived to be effective.

A 12 months age gap can make an enormous difference in performance capability in youth competitions (Barnsley & Thompson, 1988). Therefore, selection processes that are based on performances of children are likely to lead to a disproportionate number

of sport participants tending to be born in the early part of the selection year, as already reflected in the British data presented in the previous section:

> *Where advanced physical development is an advantage, the youngest players (biologically and chronologically) are considerably disadvantaged. Many 'talented' children may be overlooked simply because they are born too late in the selection year and are thus less developed physically.*
>
> (Helsen, Hodges, Van Winckel, & Starkes, 2000, p.730)

Interestingly, research into age precocity of athletes around the world has found similar asymmetries in birth-date distributions within teams (see Table 4.2). For example, Barnsley, Thompson, & Legault (1992) found that players within all teams in the 1990 World Cup and under-17s and under-20s tournaments in football tended to be born within the early part of the selection year. Twenty-four countries are represented within the World Cup (see Table 4.3) indicating a worldwide trend within football. These research findings imply that, although it has clearly been established within Section 2 that talent detection and identification processes based on performance levels will de-select potentially talented individuals, such processes continue to be employed widely.

Table 4.2: Research that has Established Asymmetries in Birth Date Distributions

Sport	Team	Reference
Football	Belgium	Helsen et al. (2000)
	Sweden	Brewer, Balsom & Davis (1995)
	UK	Brewer, Balsom & Davis (1995)
		& Baxter, Jones, & Helms (1996)
	World Cup	Barnsley et al. (1992)
American Football	North America	Glamser & Marciani (1992)
Baseball	North America	Thompson, Barnsley, Stebelsky (1991)
Cricket	UK	Edwards (1994)
Hockey	Canada	Barnsley, Thompson & Barnsley (1985)
	Canada	Barnsley & Thompson (1988)
	Canada	Boucher & Halliwell (1991)
Ice-Hockey	Canada	Boucher & Mutimer (1994)

Table 4.3: Worldwide Distribution of Teams Within the 1990 Football World Cup

North America	Central America	South America	Europe	Asia	Africa	Middle East
USA	Costa Rica	Argentina	Italy	South Korea	Egypt	United Arab Emirates
		Uruguay	Austria		Cameroon	
		Brazil	Czechoslovakia			
		Colombia	Soviet Union			
			Romania			
			England			
			Netherlands			
			Ireland			
			Belgium			
			Spain			
			W. Germany			
			Yugoslavia			
			Scotland			
			Sweden			

The importance of relative age in selection processes was emphasised recently in football within Belgium. Helsen et al. (2000) highlighted how, until 1997, the Belgium selection year started on 1 August and ended on 31 July. Youth players born between August and October (the early part of the selection year) were more likely to be identified as talented and eventually become successful senior players. In contrast, players born later in the selection year tended to drop out of football as early as 12 years of age. However, the change in the start of selection in 1997 to the first of January has resulted in a shift in birth-dates of individuals being selected. Only individuals within the 16 to 18 age group did not experience this shift. This is probably because those players who were born in the first and second quarters of the year (January to July) were deselected before the age of 16, due to the old selection process. This highlights the problem with employing performance criteria for identifying talent since, on average, those individuals born later in the selection year are likely to be later maturers. Of relevance, Malina, Reyes, Eisenmann, Horta, Rodrigues, and Miller (2000) found that within Portugal, football appeared systematically to exclude late maturing boys and favour average and early maturing boys. Consequently, late maturers are likely to be eliminated during adolescence and will not have the opportunity to develop the required skills to be reselected into the sport once they have matured physically. Unfortunately, the success of a country in sport is often attributed to their talent detection and identification methods with little consideration given to alternative causes of success. For example, due to Malaysia's success in badminton, the performance based TI models they employ are considered effective.

4.2.2 Anthropometric Models

The use of scientific talent detection and identification programmes was initiated within East and Central European countries (Bompa, 1994). These models were based almost exclusively on identifying the physical and anthropometrical characteristics of elites in younger athletes. Indeed, the Olympic success of Bulgaria, Romania, and East Germany in the 1960s and 1970s has been attributed largely to scientific talent detection processes (Bompa, 1994). As a result of successful sporting countries employing anthropometric based TI models, similar systems have emerged, and continue to emerge, worldwide. For example, within China, the selection of gymnasts occurs by considering the physical and anthropometrical profile of children aged 7 to 9 years (Ho, 1987). Within Canada, although ultimate selection is determined by performance within competition, initial selection of gymnasts is also based on physique:

> *The Canadian testing program has concentrated very heavily on physical characteristics [e.g., weight and height] when considering young athletes, since their chances to succeed are slim when they don't have those qualities.*
>
> (Bajin, 1987, p.37)

The problems with talent detection and identification programmes that are based on anthropometrical and physiological measurements of the individuals have been highlighted; namely, that the physically mature will tend to be identified for strength sports and the less mature for coordination sports. In addition, as with the selection of individuals based on performance, individuals born in the early part of the selection year are likely to be identified into strength sports.

The age at which an individual specialises in elite-sport programmes varies depending upon the sport. However, early specialisation is very common in the Soviet Union. The earliest specialisation occurs in women's gymnastics, swimming and figure skating, with selection occurring at ages 4 to 5 years of age (Jefferies, 1986). Individuals involved in specific sports at this age are unlikely to develop the fundamental movement skills needed if transition between sports is required.

4.2.3 Why such Success for the Communist Nations?

The competitive success of the Soviet states seemingly verifies the superiority and efficacy of the communist nations' talent detection and identification procedures. However, the lack of empirical support for the processes employed implies that there must be alternative explanations for their performance. An analysis of the sporting culture of these countries and their underpinning philosophy of sport involvement may provide one such alternative.

In examining this social context, Riordan (1990) highlights how, since the revolution of 1917, sport within Eastern Europe (Russia, Poland, Bulgaria, Czechoslovakia and, to a lesser degree, Hungary and Romania), developed under direct central control. The divergent paths that sport development took in East and West Europe are apparent.

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> *In the case of Russia, not only did the communists inherit the largest nationalised industry in the world, they also took over a centralised state sports system with strong military and utilitarian connections. This centralized state control, primarily intended for mobilising the population for the war effort, developed into a military training organisation that, once the fires of Civil War and Revolution had died down, became the basis of the government Sports Committee.*
>
> (Riordan, 1990, p.71)

Compare this state controlled sport system within Eastern Europe, to the system that prevailed in North America and the United Kingdom, where governing bodies of sport were both separate from one another, and independent of government. Furthermore, whilst western clubs primarily specialised in a single sport, "Russian and other East European clubs grew up around military training and Olympic-type multi-sport organisations" (Riordan, 1990, p.72). Within Eastern Europe, sport became a weapon, an arena for defeating one's 'ideological opponents' (Riordan, 1990). Consequently, in the immediate post war years, Soviet sports federations that were affiliated to nearly all the major world sports bodies and Soviet athletes were competing regularly at home and abroad.

This decision to 'take on the world at sport' led to radical change in the political attitudes to sports in both capitalist and communist states, especially within the Soviet Union (Riordan, 1993). Winning was not something to be congratulated but was expected. Riordan (1993) quotes Andrei Karpox, a ski coach:

> *In 1952 we had prepared a good team of the world championships. Not long before them I was summoned to the USSR Sports Committee and asked whether I could give a guarantee that we would win. We well knew what could happen should we not keep our word - knowing when the demand for invariable success came. I said I could not give a hundred percent guarantee. Then I was told we would not be going ...*
> (p.249)

The scope and strength of this expectation was intense. For example, in the 1952 Olympic Games, the USSR was joint winners of the medal table with the USA. However, because they had not "won" the Games outright, the entire USSR squad suffered some disgrace upon its return.

Since the USSR committed itself to sport, by deciding to join the Olympic movement in 1951, potential world champions have been supported financially, allowing them to train on a full time basis. These athletes claimed full time employment as army officers or skilled workers, or full-time students (Riordan, 1993).

> *Valuable resources were used to buy foreign sports equipment and to pay dollar bonuses to athletes who won Olympic and world championship medals. For a gold medal at the Seoul 1988 Olympics, for example, Soviet recipients gained 12,000 rubles (6,000 for silver and 4,000 for bronze medals; since the Soviet team won 55 gold medals and 132 medals overall, it cost the USSR Sports Committee about a million rubles (almost half paid in dollars) in bonuses alone*
> (p.253).

Riordan (1993) highlights how funds were provided for athletes within sports that had a minority following (e.g., rowing, weightlifting and wrestling) so that the socialist states were ensured of dominating at the Olympics. Thus, the success of the USSR is not that surprising when considering that professionals were competing against true amateurs. Additionally, it is now well documented that there was widespread use of performance enhancing drugs with athletes as young as 7-8 years old .

4.2.4 Summary

Whilst the practical success of East European athletes on the international arena is evident, no quantitative estimation has been produced regarding the contribution of the talent detection and identification processes employed. Indeed, it has been argued that the procedures are empirically flawed. Riordan (1986) warned against "believing that either the Soviet or the GDR TI system is scientifically tried and tested from start to finish" (p.228) and that "over half of those selected in the early stages of TI for sports schools do not attain the anticipated performance levels" (p.227). The sporting success of communist countries is therefore much more likely to be a result of their sporting culture than talent detection and identification procedures. Athletes have received financial support since the USSR committed itself to international competitions. Additionally, some consideration must be given to the role of performance enhancing drugs in their success. In short, building a talent detection and identification system on the basis of the communist success would appear to be both empirically and ethically flawed.

4.3 Talent Search and Sport Interactive

Building on the almost legendary changes in fortune generated in Australia, many in the UK have seized on the Sport Search programme (Hoare, 1998) as a good basis for TID. Based on the belief that different biological profiles are necessary for success within different sports, the programme appears to offer a clear and simple data-driven means of guiding individuals towards 'appropriate' sports. It would appear that, based on the literature available and the normal mode of application, the following assumptions underpin both the Scottish 'Sport Interactive' and Australian Talent Search programmes:

a. Distinct anthropometrical and physical profiles characterise and determine successful performance in different sports.
b. Determinants of performance and determinants of potential during adolescence are synonymous.
c. Consequently, anthropometrical and physical profiles of adolescents are the best indicators of potential talent within different sports.

4.3.1 Empirical Basis of Talent Search and Sport Interactive

Previous research has identified unique anthropometrical, physical and physiological profiles that are associated with success in different sports (e.g., Tanner, 1964). Consequently, the measurement of these dimensions within a talent detection and identification model initially may appear justified. For example, height has been correlated with successful performers in high jump and basketball (Tanner, 1964), and

flexibility has been shown to be correlated with success in sports as diverse as freestyle wrestling (Callan, Brunner, Devolve, Mulligan, Hesson, Wilber & Kearney, 2000) and swimming (Bloomfield, Blanksby, & Ackland, 1990).

Sport Interactive weights anthropometrical, physical and physiological attributes based on the profile of successful adolescent players (Hoare, 1996). For example, height has been correlated with performance in basketball (De Garay et al., 1974). Consequently, an individual who scores well on height in Sport Interactive, depending on the rest of their profile, may be guided towards participation in basketball. The National Sports Council for Malaysia also employs similar anthropometric and fitness based talent detection and identification models. However, a number of additional factors need to be considered in relation to their efficacy.

Although, anthropometric, physical and physiological variables have been correlated positively with performance, as the earlier review of literature clearly shows, the determinants of performance and potential at adolescence are likely to differ. Due to their unstable nature, mature values are hard to predict. For instance, an individual who is relatively small during adolescence will not necessarily retain this characteristic into adulthood. In similar fashion, since aerobic capacity is affected by body mass and maturity (Welsman & Armstrong, 2000), performance on the multi-stage fitness test is also unlikely to remain relatively stable between individuals. Similar problems exist with measuring anaerobic capacity since the metabolic characteristics underpinning the relevant energy responses are also subject to growth influences. In a BOA report on TI and selection, Borms (1994) reported "the full range of capabilities for anaerobic responses would not be evident until the later stages of adolescence or during young adulthood, making it difficult to predict ability in younger subjects" (p.4). Beunen et al (1981) highlighted the influence of anthropometric dimensions, skeletal maturity, socio-cultural factors and sports participation on running speed, flexibility and explosive, static, function and trunk strength.

Additional analysis of the weightings within Sport Interactive highlights that, as per the research results presented earlier, early maturers are likely to be identified for strength sports (e.g., rugby) and late maturers for coordination and gymnastic type sports (e.g., diving). Early maturers are likely to excel initially in strength sports due to the ability to overpower their competitors through strength and size. Similarly, late maturers are likely to excel in coordination and gymnastic activities due to the biomechanical efficiency resulting from short levers. For example, a smaller lighter body in gymnastics and diving would reduce the whole-body moment of inertia, allowing quicker completion of twists and somersault revolutions. However, individuals in both of these groups may not maintain this beneficial physical profile into adulthood. Clearly, Sport Interactive and Talent Search do not distinguish between the determinants of performance and potential and therefore will be unlikely successfully to identify talented individuals. In fact, what is most surprising is that the scheme has received so much attention when its tenets are so obviously questioned by the empirical literature.

There are other concerns with the Sport Search approach. Even if performance determinants did equate with potential during adolescence, research has shown clearly that the determinants of performance for females and males are rather different

(Pollock et al., 1986). For example, Carter and Ackland (1998) found substantial differences in size, proportion, somatotype and body composition between male and female senior divers. However, within Sport Interactive, no distinction is made between female and male values within any sport.

Finally, it also has been shown that, as performance levels improve the importance of anthropometrical factors declines. This is particularly true for team sports where factors such as effective scanning and decision-making are an integral part of performance, and play an increasingly powerful role in discriminating elite from intermediate performers (Hoare & Warr, 2000). Interestingly, unlike Australia, but similar to Northern Ireland, team sports are included on the Sport Interactive programme. The empirical justification for the inclusion of team sports is unclear. In summary, any talent detection and identification model that only considers biological factors is unlikely to be monitoring true determinants of potential. Indeed, research has shown that the attributes that determine the extent that an individual is able to progress along the athletic continuum are largely behavioural in nature (Kunst & Florescu, 1971). That is, there appears to be a certain behavioural focus that an individual needs in order to acquire and perfect skills. Further, the performance of an individual once they have mastered skills also appears to be influenced heavily by psychological factors (Kreiner-Phillips & Orlick, 1993). However, Sport Interactive does not consider such factors, a serious limitation to its capacity to tease out those with the potential to succeed.

4.3.2 Performance on Basic Skills

As well as anthropometrical, physical and physiological factors, Sport Interactive profiles individuals on a small range of performance tasks (e.g., catch). Research has been cited already in the review that shows that, to be successful within sports/ activities, individuals require the relevant fundamental motor abilities (e.g., Seefeldt et al., 1979). For example, the ability to catch a ball clearly underpins successful performance in sports such as cricket and netball. However, since these skills are not inherent (Gallahue, 1982), performance levels of individuals will be influenced by the quality of prior movement experiences. Therefore, poor performance on motor tasks may imply a lack of prior relevant movement experiences rather than a lack of talent per se.

Positively, within Sport Interactive, those individuals who are identified as potentially talented are invited to attend a fundamental movement skills programme. The consolidation of fundamental movement skills prior to specialisation is a feature that is well in keeping with the literature. This process should equip children with the skills necessary to achieve in a particular field, but also to transfer successfully between sports. However, the routine inclusion of all children into a fundamental movement skills programme prior to any identification of talent would appear to be even more beneficial, both to balance opportunity and to facilitate subsequent participation in physical activity (cf. Jess, 1999).

In conclusion, it would appear that each of the three assumptions that appear to underpin the Talent Search aspect of Sport Interactive is empirically unsound. Sport Interactive is likely to identify those adolescents who are able to perform best within a specific sport at the time of testing, but consideration of the literature would suggest

that it might fail to detect those with potential talent. Crucial omissions, coupled with oversimplifications based on a limited range of variables are the major apparent flaws. As well as a talent detection and identification tool, Sport Interactive has also been launched as a participation tool. Randak (1998) identified a number of Sport Interactive aims:

- To provide stimulation for participation.
- To steer children to sports and activities that they are suited to and prefer.
- To optimise potential for all individuals to achieve sporting success.
- To develop links with governing bodies, clubs and local authorities.
- To provide talented youngsters with the opportunity to develop their sport skills.
- To raise standards of sporting achievement by maximising the number of gifted athletes participating in certain sports.
- To seek to stem the contraction of after-school sports.
- To seek to enhance cross curriculum links, especially with health, information technology and physical education.

Clearly, as well as a talent detection and identification model, Sport Interactive has been developed as a tool for increasing children's physical activity levels. Positively, the programme recognises various participation and development pathways and proposes increased links with NGBs, clubs and local authorities. Similarly, the role of after-school activities in promoting physical activity is acknowledged and the halting of their demise identified as a major goal. Nevertheless, the use of Sport Interactive as a promoter of 'physical activity' fails to address fundamental reasons underpinning lack of uptake of, or dropout from, physical activity. Jess (1999) has highlighted how low physical activity levels post growth spurt is much more a factor of perceived competence than it is lack of knowledge or even opportunity. In a recent review of the Australian Sport Search programme, Wright, Webb, Rowland, Viallee and Wilsmore (2000) reported that only 11.6% of participants had taken up a new sport since their involvement in sport search. The low success of Sport Search may be an indication of its failure to consider true participant motives. In fact, the database of clubs was generally perceived to be the least exciting and relevant component of the programme by the majority of students. Additionally, teachers primarily used Sport Search as a support tool for teaching fitness but it was infrequently employed to link children with community organisation.

4.3.3 The Role of Talent Search in the Sporting Success of Australia

The Talent Search programme is widely considered to have been a success in identifying potential elite performers, with the often-cited example of an Olympic gold medallist identified from the 1988-rowing programme (Hahn, 1990). In 1994, after Sydney was awarded the Olympic Games (Hoare, 1998), Talent Search developed into a national talent detection programme. Children were screened for potential within athletics, canoeing, cycling, rowing, swimming, triathlon, water polo and weightlifting. Multiple world junior championship medallists and representatives were identified as a result of the national Talent Search programme (see Table 4.4). The obvious question is therefore, if Talent Search is so fundamentally flawed, how has it produced such enviable outcomes? Based on an in-depth consideration of the available data and information, we would argue that this success is due to a

combination of factors including the complexity of the focus sports, the age at which individuals were profiled and the sporting culture of Australia.

Table 4.4: Athlete achievements in Talent Search 1994-97

Achievement:	
World junior championships – medallist	**16**
World junior championships representation	**54**
National junior championships	**201**
National junior championships – placing ($1^{st} - 3^{rd}$)	**491**
State sport institute/ academy of sport scholarship	**31**

Firstly, the differential effectiveness of the programme on different sports must be considered. Earlier sections have suggested that anthropometrical and physical determinants are likely to be better predictors of performance within closed rather than open skill sports. It was argued that within open skill sports (e.g., rugby), due largely to the dynamic and unpredictable environment, there are multiple determinants of performance and consequently the significance of physique declines. It is noticeable that Talent Search has concentrated on identifying talent in closed sports that are characterised by a stable and predictable environment. These sports have included athletics, canoeing, cycling, rowing and weightlifting (Hoare & Warr, 2000). Therefore, the success of Talent Search is likely to be inflated somewhat if only these sports are considered.

A second important consideration relates to the apparent success of Talent Search, in the face of the considerable literature that attests to the instability of biological factors through adolescence. An explanation for these apparently paradoxical results is evident when the procedures employed within the focus sports are analysed. Whilst the programme was originally designed to be employed with 14-16 year olds, an age group where anthropometrical and physiological factors are likely to be highly unstable, the identification of talent for the cycling and women's rowing programmes targeted 16–18 year olds. At this age group, both males and females will be post pubertal, and anthropometrical and physiological factors will have stabilised. That is, relative differences among individuals will be maintained into adulthood. Consequently, the employment of Talent Search with 16-18 year olds allowed those individuals with favourable and relatively stable physiques for rowing and cycling to be identified. It is interesting to note that the major success of Talent Search has been reported within these sports.

The third potentially confounding factor relates to the social context in which Talent Search was developed, namely the Australian culture.

> *"Organized sport looms large in the lives of many Australian children because it is so inescapably a part of the adult culture. The pressure to participate, or to back up a decision not to, is there both at school and outside".*
>
> (The National Times, Feb. 3-9, 1984, p.20)

During the late 19th and early 20th century, sport increasingly became, and continues to be, an enormously important vehicle for cultural expression within Australia. The

significance of sport to Australia is evidenced by the adulation experienced by successful sportsmen and sportswomen (Madalinski, 2000), and the reference of sport in Australia as a national 'religion' or 'obsession' (e.g., Jobling, 1987). Horne (1965, cited in Jobling, 1987) stated that:

> *Sport to many Australians is life and the rest a shadow. Sport has been the one national institution that has had no "knockers". To many it is considered a sign of degeneracy not to be interested in it. To play sport or watch others and to read and talk about it is to uphold the nation and build its character. Australia's success at competitive international sport is considered an important part of its foreign policy. (p.92)*

Sporting nationalism was initiated within Australia following the success of Edwin Flack as their first gold medallist at Athens 1896. This nationalism was maintained and cultivated throughout the 'glory days' of the Melbourne Olympics (1956), the desolate years of the 1970s, and the return of Australia to the international sporting stage in the 1980s (Magdalinski, 2000, p.320). Consequently, Australia ended the 20th century and began the 21st century with a sense of sporting identity founded on its athletic heritage. Whilst Magdalinski clearly demonstrates how this athletic heritage is 'largely mythical', since it is founded on the 'reconstruction' of an imagined history based on the "projection of selected memories and the obliteration of rejected memories" (p.320), their 'reconstruction' of the past only serves to highlight the significance attributed to sport in the Australian culture. The establishment of sport as a central feature of the national culture has led to its formation as a "potent expression of the nation's soul" (Horton, 2000, p.66), which has resulted in high levels of participation and attrition:

> *Sport can, and does, communicate a sense of identity and belonging and the relationship between family and junior sporting achievement was and is a major socializing force that emanated, and emanates, from the process of sport in Australia. The competitive intensity of junior sport and the nature of its support are, and have been, two of the most significant characteristics of the Australian sport culture that have assured sport its pre-eminence in post and present Australian society.*

> (Horton, 2000, p.80-81)

A strong relationship between the number of players within a sport and success at national level is likely. For example, both Australia's senior and junior female netball squads currently are ranked number one in the world whilst England is ranked third and fourth respectively. If we compare the netball participation bases, 350,000 athletes are registered in Australia compared to only 47,000 in England. Clearly, and especially if TID processes rely on natural selection of individuals into sport, or selection from current participants, the nation that has the larger participation base probably will develop more world-class athletes. Consequently, the influence of culture must be considered when looking for the determinants of sporting success within a nation, and this would appear to have had a considerable influence on the performance of Australia. Specifically, we would suggest that the support, status and rewards offered to a sportsman in Australia are so great compared to the British scene

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that the transfer of any approach is likely to be fraught with difficulty. Indeed, a BOA report (Borms, 1994) illustrated the importance of acknowledging the unique social, physical, and cultural conditions existing in different countries when designing talent systems.

SECTION 5: TALENT DETECTION AND IDENTIFICATION METHODS IN NON-SPORT SETTINGS

Given the complexity of talent detection and identification, there may be some benefit in considering applications in other domains. Accordingly, this section considers the talent detection and identification process, together with the nature of talent itself, in other areas of human performance.

5.1 Gifted Artists and their Detection/Identification

In a similar fashion to early (and some recent!) talent detection and identification schemes in sport, early talent detection and identification schemes in the artistic domain identified talented students through their output (Clark and Zimmerman, 1984). It is worth noting that no discovery of talent through this method has occurred in individuals younger than eight years of age (Howe, Davidson and Sloboda, 1996). Interestingly however, Winner and Martino (1993, cited in Howe et al, 1996) contend that this is not because talent does not exist, but because it is not being identified correctly. In this regard, Hollingworth (1923) stated:

> *At present we have no means of gauging talent in drawing except by grading a finished product...such a means does not always separate talent from training.*

Researchers realised quite early that the importance of interest, desire, persistence and self-motivation could not be under-estimated in the search for artistic talent (Kough and Dehaan; 1955, Conant and Randall, 1959). However, only recently have projects attempted to rectify the narrow approach of early schemes, taking into account a broader range of characteristics. Research in the late 1970s and early 1980s into the links between intelligence and artistic talent, refuelled the interest in identifying art ability. In a study typical of this developmental period, Tuttle and Becker (1980, cited in Clark and Zimmerman, 1984) attempted to assemble checklists of characteristics and behaviours common to talented individuals, through use of biographical data. Talented students were argued to be the ones who demonstrated the greatest number of certain key characteristics. Attributes were grouped under four main headings: interest in art, learning behaviours, social behaviours and performance patterns (Luca and Allen, 1974, cited in Clark and Zimmerman, 1984). In keeping with our arguments within the earlier sections, Tuttle and Becker's model recognises the need to move away from performance-oriented to potential-oriented talent detection and identification procedures.

5.2 Talent in the World of Dance and Music

Auditions have been used to identify talented dancers and musicians in the past and, despite criticisms (e.g., Baum, Owen and Oreck, 1996), persist to this day. Single auditions are notoriously unreliable, the pressure of the context and the resulting anxiety results in a poor predictive validity (Nunnally, 1978). Auditions are also susceptible to specific previous training and thus are testing developed, rather than potential, talent. In other words, single auditions measure current achievement not

aptitude. Researchers studying expertise (Renzulli, 1978, cited in Sternberg and Davidson, 1986; Gardner, 1983) however, argue that motivation, commitment, and creativity over time are as important as ability, but that these factors may well be inhibited during a single audition.

The Dance School of Scotland

In 1983 with the support of the Scottish Ballet, the Dance School of Scotland was established as part of Knightsbridge Secondary School in Glasgow. The dance school was developed following an enquiry into the needs of gifted musicians and dancers by the Scottish Education Department (SED, 1976). Individuals are able to enter the dance school either in S1 (11-12 years of age) or in S5 (15-16 years of age). Places within the dance school are advertised throughout Britain and applicants are selected based on two auditions. Following the first audition in February, applicants perceived to have the most dance potential are invited to attend the second, and final, audition in March. As mentioned above, a limitation of this single audition approach is that expression of determination and a sense of performance can be hampered (Nunnally, 1978).

Dance pupils are integrated, as far as possible, into mainstream education. Despite the 25 percent reduction in the academic timetable, and the dance classes they attend, the dance pupils have the same daily experience as mainstream pupils. A major advantage of housing the Dance School within a comprehensive school is that, not only do pupils have their potential talent developed in a supportive environment, but academic attainment is also stressed (Denny, 1995). Academic attainment is crucial for those individuals who fail in the world of dance due to ability or injury, and also to provide dancers with career options once they retire. Thomson (1992), in a report on 'giftedness, excellence and sport' for the Scottish Sports Council, stressed the importance of nurturing physical ability without the individual having to sacrifice an academic career.

Selection into the Dance School of Scotland is based on criteria that pertain to dance talent, dance potential and commitment (Good, Baird and Ross, 1986). In a review of the dance school, Denny (1995) stated that:

> *"...the audition panel are looking for a well-proportioned, flexible and mobile physique, a good sense of rhythm and musicality, a sense of balance and co-ordination of movement, enthusiasm, determination, concentration, a strong sense of performance and a lively intelligence."*
>
> (p.5)

To enter the school S5 applicants are expected to have relevant experience in classical ballet, modern, jazz and tap dance. However, no previous dance training or experience is expected from S1 applicants and selection is based on applicants' fundamental movement skills, such as rhythm, balance, and co-ordination (Denny, 1995). The advantage of monitoring fundamental movement skills within selection processes has already been highlighted (see Section 2.3). In short, fundamental movement skills underpin successful movement and skill acquisition across a range of performance settings. However, the influence of previous movement experiences on individual

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abilities should also be recognised. Positively, recognising the distinction between talent potential and current performance levels, the dance school highlights the importance of psychological as well as physiological factors (Denny, 1995). The impact that psychological characteristics have on both skill acquisition and performance, and the need to include them in any talent detection and identification model if potentially talented youngsters are to be identified, has already been illustrated (see Section 2.4). Unfortunately, little information exists on how psychological factors are taken into account within the Dance School of Scotland. For instance, how is determination measured? Further, whilst the importance of psychological factors are recognised, selection appears to be primarily based on performance and physique. For instance, in S2 and S4, dance pupils are streamed by the school based on physical criteria such as size, shape, flexibility and the ability to pick up routines.[1]

> *The rationale, presented by Denny (1995), for the physical focus of the Dance school is that 'the human body is the instrument through which the pupils are ultimately going to express their art' (p.5). However, although a certain physique may be advantageous for dancers, the identification of some positive characteristic in a pre-adolescent child ... does not guarantee that the characteristic will remain throughout the process of maturation toward the adult form.*
> (Ackland & Bloomfield, 1996, p.57).

Consequently, it is difficult, if not impossible, to predict adult physique in prepubertal adolescents. As previously discussed, talent detection and identification procedures that emphasise physique are likely to eliminate those talented, but late developing, individuals (see Section 2.2). Additionally, individuals may be identified as talented despite the fact that following puberty their physique will no longer be appropriate for the world of dance.

Although the identification process for the Dance School lacks theoretical justification, a large number of individuals from the school go on to follow successful dance careers. Very few individuals drop out of dance altogether and the majority become involved in further dance training after leaving the school. A minority of individuals also gain entry into dance squads such as the Royal Ballet. The success of the Dance School of Scotland can primarily be attributed to the quantity and quality of deliberate practice being undertaken by the dance pupils. Referring to theories of deliberate practice, it was stated earlier that almost any individual can reach an above average level of performance if quality training is undertaken over a number of years (Ericcson et al., 1993). Consequently, by encouraging dance pupils to train daily under the tuition of an expert coach it is almost inevitable that large numbers of individuals will succeed. However, the main criticisms still ensue: successful applicants are admitted based on two auditions, and many are excluded following just one audition. In addition, physical make-up is emphasised during auditions, with little explanation of how psychological factors are taken into account.

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[1] Personal communication with the assistant director of the Dance School of Scotland.

The Talent Beyond Words Initiative

The 'Talent Beyond Words' (Baum et al., 1986) initiative attempted to move away from the 'single audition' process for identifying talent. This initiative responded to the realisation that disadvantaged children would never be identified during a single audition, despite their possible potential, as they would be lacking the specific training of advantaged individuals. Consequently, Baum et al. developed an observational model, designed to target talented individuals who might otherwise be overlooked (Baum et al, 1996). The project ran in New York for two years and incorporated 396 3rd grade children from a range of backgrounds. Individuals took part in seven consecutive weekly audition classes. During these 'audition' sessions, raters used an observational checklist known as the Talent Identification Instrument (TII), which was designed to identify skills, motivation, and creativity (see Table 5.1). Within sport, it is well accepted that there is a hierarchy of skill development, from fundamental, or basic skills, such as, running, jumping, catching through to more specialised perceptual and decision-making (Gallahue, 1982). Within the arts setting, the TII follows a similar track and considers core basic skills (e.g., rhythm), which may be present without specific training. In addition, and most pertinently to the arguments presented in this review, the TII instrument also takes into account for the many potential factors that lead to an individual being talented. Thus, creativity and psychological measures are considered. Of course, a possible problem with the TII is that many of the criteria being employed are subjective, for example, 'communicates feelings' and 'performs with energy and intensity' (see Table 5.1). Despite this however, inter-rater reliability estimates among the experts ranged from 0.65 to 0.79 for music, and 0.78 to 0.82 for dance, over the seven weeks (Baum et al, 1996), albeit that only three raters were involved.

Table 5.1: Key Words and Definitions for the Identification of Talent in Dance and Music (adapted from Baum et al., 1996)

Talent Identification in Music			Talent Identification in Dance		
Skills	Motivation	Creativity	Skills	Motivation	Creativity
Physical control: knows by feeling, can make adjustments, can balance on one leg, strength in arms, can maintain corrections	Ability to focus: directs attention, makes full commitment to the movement, is interested and motivated in class	Expressiveness shows pleasure in movement, performs with energy and intensity, is fully involved, communicates feelings	Rhythm: puts beat in the body, able to sustain an even beat, replicates rhythmic patterns, can play repeating patterns, anticipates, waits for proper moment to begin, can find underlying pulse or beat	Enthusiasm: responds joyfully, eager to participate, curious, asks questions, is open to unfamiliar styles of music	Expressiveness: responds with sensitivity, performs with energy and intensity, is fully involved, communicates feelings
Co-ordination and agility: can combine movements, executes complex locomotor patterns, can isolate body parts from one another, moves freely through space, moves quickly	Perseverance: doesn't give up easily, practices over time, takes time to think, tries hard to get it right	Movement qualities: displays a range of dynamics; has facility moving in levels, directions, styles; communicates subtly; moves fully; connects body parts	Perception of sound: perceives differences in tone and pitch, responds to dynamics, can match pitches, can replicate melodic phrases, is able to sustain independent part		Composition and Improvisation: improvises spontaneously, takes risks, makes surprising or unusual statements, creates sound in original ways, makes up songs
Spatial awareness: is aware of other people, adjusts to other dancers and space, evens up the circle or line, is accurate in time and space		Improvisation: responds spontaneously, uses focus to create reality, shows the details, gives surprising or unusual answers	Co-ordination: moves easily through space, able to do two or more things at the same time, can control body in movement and freeze, to sustain independent part		
Memory and recall: remembers information, can perform without following, can see and replicate movements accurately, can build sequences Rhythm: puts the beat in the body, repeats rhythmic patterns accurately, anticipates, waits for proper moment to begin, can find underlying pulse or beat					

Baum et al.'s talent detection and identification model was based upon Renzulli's (1978, cited in Sternberg & Davidson, 1986) three-ring model of giftedness. Renzulli proposes that giftedness results from interactions among three traits, (1) above

average ability, (2) creativity, and (3) task commitment. This interactional model of giftedness is in keeping with Simonton's (1999) multiplicative, as opposed to additive, model of talent detection and identification (see Section 3). Consequently, equally talented individuals within performance domains may have very different distributions of the same key talent determinants. Thus, one piano prodigy may have a better rhythmic sense, another a superior feel for melodic line, but their overall talent may be indistinguishable. Additionally, giftedness can occur in different individuals at different times and under different circumstances, a feature that is also highlighted by Simonton's model.

5.3 Detection/ Identification of Academic Talent

As within the two performance dimensions presented, talent in education is still currently identified through performance, in this case through exam and assessment marks. This outcome-oriented approach is also apparent within research where IQ tests are often employed. For example, research has attempted to distinguish between elite and non-elite athletes using IQ scores (e.g., Jeffries, 1977, cited in Howe, 1988). It has been argued however, that doing well on an intelligence test only shows us that an individual is good at that particular test (Howe, 1988), and not that potential exists. Rimm (1984) highlighted how creative children in academia are being overlooked because their grades do not imply the desired level of intelligence. Consequently, Rimm proposed a 'characteristic approach' that considers behavioural attributes displayed by talented individuals throughout their childhood. Although the advantage of Rimm's model is apparent, outcome oriented approaches continue to be widely employed. Despite their obvious drawback, schools and universities still focus on examination and assessment results. There has been however, a gradual move towards continuous assessment, rather than end of term examinations, and this method has the advantage of allowing continuous monitoring and development of students' performances.

5.4 Summary

The above real life examples originated from performance models of talent detection and identification, but in each domain there has been an attempt to move away from performance models to potential talent detection and identification models. In this regard, models have tried to identify levels of creativity, motivation, interest, desire to excel, and skill level among other attributes. Thus, although the scientific rigour of some of the models could be questioned, at least practitioners are beginning to distinguish between skill acquisition and performance and recognise the complex interaction of key attributes.

A review of both sport and non-sport practices demonstrates that there is a global perception that a range of characteristics leads to, or at least precedes, later talent. However, the perfect solution has yet to be identified. Borms (1994) reviewed 30 models of TI, search and development in the period 1974 -1994 and concluded that none of them met all the criteria proposed by the experts and researchers. Borms stated that it was not possible to "identify a definitive model or set of procedures for the selection of young people who possess 'real' as opposed to 'apparent' talent" (p.17). All too often however, the success of a country in a performance arena is attributed to the talent detection and identification procedures employed with little

consideration given to their empirical basis. For example, Sweden has been particularly successful at producing top class golfers and tennis players. However, their success is most likely due to the financial and coaching support provided to participants as well as the establishment of clear developmental pathways. Our review of sport models has clearly highlighted empirical weaknesses in the talent detection and identification procedures being employed by successful sporting countries (e.g., Australia, GDR and Russia).

A consistent limitation of practical models of talent detection and identification in all achievement domains is the lack of distinction between potential and performance levels. Outcome based procedures (e.g., exams, auditions, performances) will select those individuals within a domain who may <u>currently</u> have the best combination of attributes. The individuals selected will probably be those that are already involved in the performance domain. However, due to the range of performance areas, many individuals may never become involved in the domain where they have the most potential. Winner and Martin (1993, cited in Howe et al., 1996) highlight how many talented individuals are not recognised because their parents fail to notice or encourage their ability. Consequently, the need to establish determinants of excellence that can detect potential talent outwith a specific performance domain is apparent. Whilst both sport and non-sport models attest to the complexity of the picture, few if any researchers have really attempted a comprehensive empirical approach to this 'research minefield'.

SECTION 6: ADDRESSING THE DICHOTOMY BETWEEN EMPIRICAL EVIDENCE AND PRACTICE

6.1: Defining the Dichotomy

Earlier sections of this review hopefully have established that a dichotomy exists between what is currently being done within sport to identify talent and what is required. This information is presented schematically in Figure 6.1.

Figure a: Actual Resources in Talent
Identification

Figure b: Required Resources in Talent
Identification

⊞ Anthropometrical ▓ Fundamental Movement Skills □ Psychological
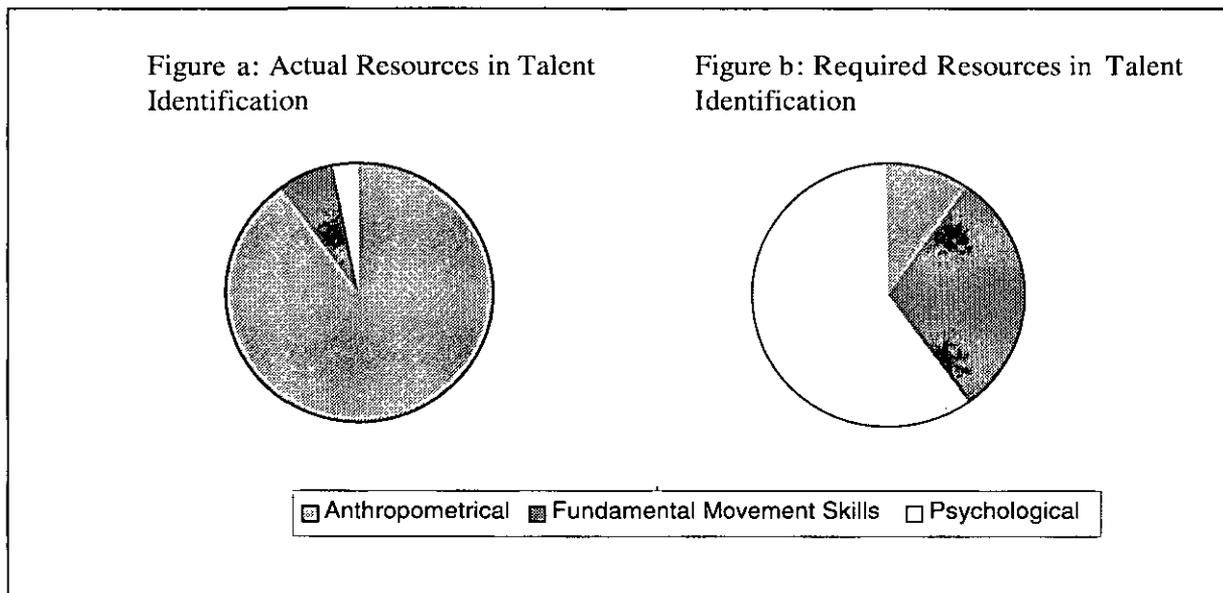
Figure 6.1: Schematic representing the dichotomy between required and actual resource distribution in talent identification processes within Britain.

Current procedures (Figure 6.1a) primarily rely on identifying innate determinants of performance (e.g., height), as opposed to potential, in an attempt to guide individuals towards particular sports. However, consideration of the literature, and the principles that underlie TID, show that, in reality, any process designed to identify and develop talent must cater for the complexity of the interaction of nature and nurture. First, simply because a component of talent (performance) is considered to be innate does not imply that the component will be visible during childhood. On the contrary, the emergence of any characteristics, even if innate, will vary from person to person. Secondly, characteristics that are influenced by the environment also would appear to have a large role in the development of an individual. Talent identification processes need to recognise and monitor the characteristics that predispose an individual to develop successfully within a domain, and this necessary balance is presented in Figure 6.1b. However, whilst it has been established that psychological factors are likely to be crucial to the process, specific information on the components that predispose an individual to acquire skills successfully is limited; this is unfortunate since this process represents the major focus of the potential hothouse environment. Clearly, further research is required to help establish TI procedures that can be employed to inform the coaching process. The means by which the precursors of skill acquisition best can be developed forms the bulk of this section.

Why such a gap between resource allocation and requirements?

Whilst acknowledging the research-practice gap in TI processes, it is more important to consider why this gap exists. The simplistic explanation would be that those individuals developing current TI procedures lack knowledge (such as presented within this review) to develop efficacious procedures. However this dichotomy, and in particular the emphasis on determinants of performance, may also be a result of the pressure on NGBs to produce results in order to achieve visibility, status and funding.

There is little doubt that pragmatic considerations of performance, reinforced by the reward/ resourcing systems implemented by World Class Performance Plans, provides a significant pressure for results on all NGBs. Favourable competitive success within sport at any age group results in visibility and status, which in turn results in greater membership and increased financial support. Consequently, the best players are encouraged to participate in club sports, while the less skilled are eliminated quickly. This pressure is no less at age group level, and has been seen to extend to lower levels of youth sport as a means by which coaches acquire status (Borms, 1994). Consequently, NGBs have become oriented towards talent selection, with major initiatives focused on performance measures as the means to identify those to be nurtured. Clearly, as the earlier sections of the review have highlighted, such procedures run the risk of eliminating potentially talented individuals.

The suggestion that the development of generic skills is crucial before the process of identifying potential, and the occurrence of early and late bloomers, both emphasise the importance of combining the process of TI and development. It is important to recognise that the key determinants of potential and the key determinants of performance are different, with the key determinants of potential being largely psychological. These determinants are not innate, and can be developed through appropriate experiences. However, the mere possession of those psychological attributes that predispose individuals to acquire skills will not lead automatically to sporting excellence, since key environmental factors are also necessary. Consequently, TI and development procedures must be considered within an holistic developmental framework.

In a British Olympic Association report, Borms (1994) highlighted the importance of viewing TI and TD as a whole. Borms stated that it is inadvisable to sustain either TI or TD as a separate entity since they both influence each other. Accordingly, this section will review the research that examines the characteristics of the environment that best lends itself to development. Current practice will then be considered, and critiqued in the light of these findings.

6.2 Characterising the 'Hothousing Potential' Environment

Opportunity and encouragement to practise

Several authors have discussed the importance of parental influence on children's introduction to, involvement in, and achievement in sport and other domains (Bloom, 1985; Brustad, 1993; Hellstedt, 1995). It is well documented that families provide the long-term continuous practical and emotional support that is required for prolonged participation in sport (e.g., Howard & Madrigal, 1990). As children progress in their sport, it is the families that meet the financial costs that arise, provide the transport to training and competition, and adapt their routines to further their child's sport career (Duncan, 1997).

Indeed, parental behaviour may be <u>crucial</u> to TD; for example, the experience of a child being labelled 'gifted' by their parents or teachers provides opportunities to develop in an optimal learning environment that may be essential for the accelerated development of the child who has talent precursors. As Bloom (1985) suggests, these opportunities for optimal development are created by the expectations for the child, which results in the use of different teaching methods and greater levels of encouragement. These observations by Bloom (1985) support theories such as the Expectancy Theory (Martinek, Crowe, & Rejeski, 1982) and the Self Fulfilling Prophecy (Solomon, Striegel, Eliot, Heon, & Maas, 1996), which maintain that coach or parental expectations that develop through their belief about the child's ability are emitted to the child via verbal and non-verbal behaviour. If these messages are conveyed consistently over time and accurately perceived by the child, then his/her behaviour might conform to the original expectation. In this regard, the Development of Sporting Talent project (DOTS, Moore et al., 1998) involving around one thousand elite athletes, coaches and National Governing Bodies in the UK produced some interesting results. DOTS showed that involvement in top-level sport seems to 'run in the family', and elite competitors are likely to come from families who themselves were involved in sport at a high level. The emphasis subsequently placed on sport, and the knowledge and willingness to give the child good opportunities to practise and develop, are important factors in the subsequent sporting success of the child.

The high level of finances required, especially at an elite stage, is highlighted by the fact that 56% of performers under the age of 25 remain dependant on their families for financial support. Without this support it is very unlikely that these athletes would have had the opportunities required to reach elite level.

The results of the DOTS study (Moore et al, 1998) clearly show that the opportunity to practise and realise sporting potential is influenced significantly by an individual's background. Those having 'sport loving' parents, one of whom (probably) has achieved high levels of sporting success, being born into an affluent family, and attending an independent/private school appear to hold a 'first class' ticket to sporting success. An equally talented person, but born into less favoured social circumstances, at best has a 'third class' ticket and at worst no ticket at all.

Other concerns restricting practice opportunities in the UK setting relate to the low numbers of 'master' coaches and lack of facilities. A lack of opportunity to either practise enough, within the required facility, or under the required supervision that a 'master' coach can provide, are obvious limitations for athlete development. Indeed, many performers in the UK regard themselves as lucky to have a top coach, or have had to change clubs or area to find good coaching and facilities (Moore et al, 1998). In addition, evidence from the TOYA study (Rowley, 1992) shows that inaccessibility to higher quality coaching for some athletes resulted in early retirement from their sport, an avoidable and sad waste of talent.

The nature of, and requirement for, Deliberate Practice

It takes ten years of extensive practice to excel in anything.
                    (Dr Herbert Simon – Professor of Computer Science and
                    Psychology, Nobel Laureate, cited in Balyi, 1998, p.8)

Even with the opportunity to practise over an extended period of time, a high quality of training is essential for the achievement of elite levels of skill. A review by Ericsson et al. (1993) shows that maximal levels of performance are not attained automatically as a function of extended experience. Rather, it is attained as a function of deliberate practice; that is, activities that have been specifically designed to improve the current level of performance.

There are several conditions of practice in the motor control literature that must be considered in order to optimise skill acquisition. The most important condition to consider is the amount of practice that is required (Magill, 1998). There are many ways in which methods of deliberate practice can be modified, structured, improved and otherwise changed to influence performance and skill acquisition. However, it must be remembered that some methods influence temporary improvements while others have a relatively permanent effect. These methods highlighted by Magill include:

- Consideration of pre-practice factors, including motivation for learning, verbal information and modelling.
- Type of feedback.
- Distribution of practice (e.g., massed or distributed).
- Variability of practice (how much variety of practice is required to obtain the aims of the session).
- Contextual interference (e.g., blocked versus random practice).
- Mental practice.
- Part versus whole practice.

Deliberate practice is an effortful activity that can be sustained for only a limited time each day without leading to exhaustion. Consequently, to maximise gains from long-term practice, individuals must avoid exhaustion and must limit training to a level where they can recover on a daily or weekly basis.

In using this research to guide the design of practice however, some particular considerations must be applied. Firstly, the training environment is very complex and unfortunately much of the research remains very specific to certain skills, sports, environments and individuals. "A substantial array of variables, specifically task and subject variables, mitigate the influence of particular factors in optimising the transfer of learning. Therefore, few principles can be identified that will generalise beyond a very narrow range of independent variables" (Chamberlin & Lee, 1993, p.237). Unfortunately, the transferability of much of the motor learning literature to long-term development is questionable. Traditional research on learning is often limited to a few sessions and therefore is of little guidance to understanding the long-term development of performance that is extended over months and years (Ericsson et al., 1993, p.370).

These considerations notwithstanding, strong consistent links are found in an academic environment that shows that engagement with the subject matter is a powerful predictor of achievement (Siedentop, 1983). This notion, called Academic Learning Time (ALT), has also been used in the physical education setting (ALT-PE). Once again however, caveats apply. Although it may be that, in an academic and PE setting, greater engagement in the subject matter (i.e., larger quantities of practice) leads directly to more achievement, it must be emphasised that these environments are very different from the performance-excellence setting. In these settings, depending on the stage of development, many individuals have already committed themselves to large quantities of practice (Bloom, 1985). Crucially

however, having reached that stage, the quality of practice is more important than the amount. For example, a study on elite archers by Van der Mars, Darst and Sacriscsany (1991) revealed that elite archers spent nearly half of their practice sessions in what is referred to as transition (organisational or managerial activities). This may appear ineffective at first sight, especially considering the relationship between successful task engagement and learning or performance. However, sport specific factors such as shoulder fatigue, imagery, and other mental skills must also be taken into account to ensure optimal benefit is gained from training sessions. Crucially, the need for training to be guided by research and developed through the consideration of developmental and sport specific factors has been highlighted.

The case for early specialisation

The appropriate structure of training appears to be of particular concern at a very young age, especially regarding issues related to early specialisation. Several studies show that early specialisation does not favour the development of elite athletes and, before adolescence, diverse sports participation is more important (Carlson, 1988; Hill, 1993). Certain problems arise when a child specialises in a sport too early. Firstly, the development of fundamental movement skills underpins the more specific skills required for the future successful performance and involvement in more specialised games, sports and activities (Armstrong, 1990; Jess, Collins & Burwitz, 1998). The unlikelihood of excelling in any sport without these basic skills has been highlighted already (see Section 2.3). In this specific regard, findings from the DOTS study (Moore et al., 1998) reveal that children with a broad range of basic skills are characterised by coaches as children with high potential. Further, the coaches believe that if a child has not acquired the fundamental movement skills required within an activity by twelve or thirteen, that they will never be able to reach the highest level in that sport.

A second problem associated with early specialisation is that children may never find the sport for which they have most potential. Early specialisation can mean that a child is 'locked' into a sport for which they have talent but 'locked out' of a sport where their talents and chances of success are greater (Moore et al, 1998). Finally, early specialisation is potentially dangerous to growing children and may be considered undesirable through restricting wider experiences:

> *Children involved in sports should be encouraged to participate in a variety of different activities and develop a wide range of skills. Young athletes who specialise in just one sport may be denied the benefits of varied activity while facing additional physical, physiological, and psychological demands from intense training and competition.*
>
> (Committee on Sports Medicine and Fitness, 2000)

Once again however the situation is complex, with a real need to avoid oversimplified statements on the dangers of early specialisation. Consider for example the popular stance on the potential damage caused by early imposition of intensive training. A study reviewing the effects of intense Training of Young British Athletes (TOYA, Baxter-Jones & Helms, 1996) found that early intensive training has no adverse effects on a child's development. No evidence was found to suggest that training affected growth, or sexual development. There was a low incidence and severity of injuries and athletes were shown to have a healthy lifestyle. Indeed, the negative effects of intensive training at a young age appeared to be outweighed by the many social, psychological and health benefits that a serious commitment

to training brought to participants. The problems are thus complex, but seem to relate more to efficacy of the early specialisation in producing champions at a later date.

The Development of Talent Study (DOTS, Moore et al., 1998) shows that serious involvement in competitive sport begins at an early age for those destined to achieve the highest level of performance. This trend towards an increasingly early involvement must be balanced against the dangers of early specialisation. NGBs need to work in innovative and co-operative ways, and not view children as a resource in the marketplace for which they have to compete with other sports. The interests of the child must always come first.

Quality and appropriate training methods have been emphasised as crucial to ensure optimal development of talented individuals. Another crucial aspect, which needs consideration when developing the optimal learning environment, is coach behaviour.

Coach behaviour

Research into coach effectiveness has focused predominantly on investigating the behaviours of coaches. Through behavioural observation, a number of characteristics have emerged to identify effective coaches. In general, effective coaches frequently provide feedback and incorporate numerous prompts and hustles, provide high levels of correction and re-instruction, use high levels of questioning and clarifying, predominantly engage in instruction and manage the training environment to achieve considerable order (e.g., Claxton, 1988; Douge & Hastie, 1993).

Although there is little doubt that these factors are important for effective coaching, there are many factors apparent in the literature that mediate the exact mix of optimum behaviour. This implies that certain behaviours are more appropriate under certain circumstances. Mediating factors include gender (coach and athlete - Lacy & Goldston, 1990), team or individual sport (Claxton, 1988), type of sport (Wandzilak, Ansorge, & Potter, 1988), high or low expectancy athlete (Solomon et al, 1996), skill level of the athlete (Lacy & Darst, 1985), the athletes' status as a starting or non starting player (Markland & Martinek, 1988), level in coaching structure (Solomon et al, 1996), stage of the season (Lacy & Darst, 1985), aims of the coaching session (Krane, Eklund & McDermott, 1991), age of the athlete (Seagrave & Ciancio, 1990), and the coaching philosophy for practice or game (Wandzilak et al, 1988). It has also been demonstrated that observational methods are not sensitive enough to distinguish between expert and less expert coaches (Abraham, Collins, Smethurst & Collins, 1997; Sherman & Hassan, 1984). This highlights the issue that it may not be the behaviour itself that characterises effective coaching, but rather the timing and rationale behind it. Indeed, research emphasising this point, shows that novice coaches sometimes use more instruction and reward behaviour than experts (e.g., Model, 1983; Claxton, 1988), tools initially associated with more effective and 'better' coaching.

Other avenues of research into coaching effectiveness have looked at the planning, knowledge structures and reasoning of expert and novice coaches. It is reported that, when planning, experts would establish objectives and how they would achieve and evaluate the attainment of their objectives in a much more focused way than novices (e.g., Jones, Housner, & Kornspan, 1995). Research into knowledge structure suggests that more experienced teachers and coaches have more chunks of knowledge that, in turn, contain more and interconnected information (Rutt Leas & Chi, 1993). Thus for example, more expert tennis coaches have

been shown to have deeper more complex reasoning for using various coaching tools to achieve their aim in a coaching session (Abraham et al., 1997).

Unfortunately, much research into coach effectiveness is concentrated within the area of attrition and development of children in youth sports where recreational participation is highlighted (e.g., Smith, Smoll & Curtis, 1979). This is obviously an extremely worthwhile cause but again gives us little insight into the development of athletes in an excellence setting. There are also vast differences in the literature regarding the definition of an expert coach (e.g., Solomon et al, 1996; Claxton, 1988; Strong, 1992). The limitation of much of this research lies in its inability to aid the understanding of what is required of an effective coach in an environment promoting the development of talented athletes, and the need for research to move toward understanding the declarative knowledge of experts is highlighted (Abraham & Collins, 1998). Understanding the aims and methods required to progress athletes from one stage of development to another is crucial. Unfortunately, research to aid this understanding currently is lacking within the UK.

The motivational environment

Creating an effective motivational environment is crucial if a talented athlete is to develop their full potential. Extremely high levels of motivation may be necessary to produce repeatedly the kind of high quality sessions that are required for elite performance (Hardy & Parfitt, 1994; Orlick & Partington, 1988). In sport, achievement behaviours associated with motivation to participate are those behaviours witnessed when an athlete tries harder, concentrates more, persists longer, pays more attention, performs better, chooses to practise longer, and joins in rather than dropping out of sport. As highlighted earlier, the influence of parents and coaches on the motivational environment is high (Duda, Chi, Newton, Walling, & Catley, 1995; Howard & Madrigal, 1990), with the social reactions of parents and other individuals in the immediate environment being very important in establishing this original motivation (Ericsson et al., 1993).

Limitations of the research into athletes' own motivation appear to lie with the separation of ego and task orientation. The little evidence that does exist suggests that elite performers have both high task and high ego orientation (Hardy, Jones & Gould, 2000). However, there is little research into the motivational environment that is required at varying stages of development. Although, it does appear that, at a young level, it is very important to develop a learning atmosphere that encourages fun and intrinsic motivation (Bloom, 1985; Balyi, 1998). This initial environment promoting fun and self-improvement focused reward develops the initial motivation which would appear to lead to a committed involvement in their chosen domain (Bloom, 1985).

The influence of family and peer support

As highlighted earlier in this section, the research on athlete families underscores the importance of the family for the developing athlete. Several authors have discussed the importance of parental influence on children's involvement and achievement in sport and other achievement domains (Bloom, 1985; Brustad, 1993; Hellstedt, 1995). The parents' role may run from under to over-involvement (Hellstedt, 1987). Research suggests that a moderate level describes parents who promote the best interests of their children, often with many personal sacrifices, while over-involvement can lead to unreasonable pressure on the child to achieve, interfering with the child's subsequent participation (e.g., Scanlan, Ravizza &, Stein,

1991; Rowley, 1992). The commitment can be a source of stress in the family (Barber & Sukhi & White, 1999) and financial hardship can arise, but without it, development of the athlete would be impeded severely. Although there has been research in this area, very few studies have provided in-depth information on how families create a positive environment to initiate and maintain life-long sport participation. However, one study, which did provide a detailed insight into the role of the family, was Cote's (1999) study of athlete families.

Cote (1999) presents an in-depth picture (Figure 6.2) of a positive family environment. Four Canadian elite or junior elite athletes and their families were selected and interviewed. The interview led to the development of three distinct chronological stages.

Investment Years (15 and over)

- Athlete increases commitment to one sport
- Parents show great interest in child-athlete's sport
- Parents help fight set-backs that hinder training progression
- Parents demonstrate different behaviour toward each of their children
- Younger sibling or twin shows bitterness and jealousy toward their older sibling's achievement.

Specialising Years (13-15 years)

- Athlete makes a commitment to one or two sports
- Parents emphasise school and sport achievement to their child-athlete
- Parents make a financial and time commitment to their child-athlete
- Parents develop growing interest in the child-athlete's sport
- Older sibling act as a role model of work ethic.

Sampling Years (6-13 years)

- Parents provide opportunities for their children to enjoy sport
- All children within a family participate in various extra-curricular activities
- Parents recognise a "gift" in the child-athlete.

Figure 6.2: Dimensions of family dynamics during three phases of development (Cote, 1999)

There are many positive aspects to this model. At a very early age the parents provided opportunities for the children to enjoy a varied participation in a broad range of activities and the talented child is recognised as 'gifted'. Other research also has highlighted the importance of these environmental factors to the development process (Bloom, 1985; Carlson, 1988; Hill, 1993). An holistic development is encouraged throughout the athlete's development, and commitment by both the athlete and parents becomes crucial, as has been highlighted in both

family and sports psychology focused research (Orlick, 2000; Cote, 1999). The parents provide the financial, practical and emotional support crucial for facilitating athlete development. Other positive aspects of this model include the incorporation of the sibling roles in the family dynamics.

Of course, the applicability of this model to a UK context is limited because of the model's development within the Canadian context. Moreover, it represents a single pathway to excellence through individual sports experiences only (rowing & tennis). This is of concern as research shows in both Canada and Britain that two pathways to excellence levels are apparent (Stevenson, 1988), and that team sports differ from individual sports experiences (Tebbenham, 1998). Finally, since research from earlier sections has highlighted the diverse nature of the maturational and developmental processes in children, physically, psychologically, behaviourally and socially, the chronological nature of this model is of concern.

With these concerns in mind, it must be recognised that the family role is essential to the successful development of the athlete. Further investigations must study the complete family environment at each of the stages, in a wider variety of sports, and within the UK context. From this understanding, guidelines can be developed to devise programmes to encourage parents and children to maintain commitment to sport and actively facilitate development.

6.3 Optimising Environmental Factors to Facilitate Talent Development

Clearly, there are a number of environmental factors that facilitate the development of the athlete and enable the skill development that is essential to eventual performance. However, it is also important to recognise that the significance of certain factors will change as the performer develops through different stages or levels of development. For example, the significance of family financial support may become less crucial once a certain level of excellence is reached and personal income is sustained, or the significance and utility of external encouragement is reduced as internal reward systems, goal setting ability, and high levels of personal motivation, are developed.

The changing significance and influence of certain factors may create large changes in the needs of the athlete. For example, the coach/athlete relationship required to facilitate development may change from a kind, cheerful and caring relationship to one of fear and respect as a young developing athlete becomes elite (Bloom, 1985). Indeed, without such a change the realisation of full potential may not be possible. In this regard, it must be emphasised that the transitions that characterise the process of moving from one stage of development to another is not characterised by chronological age. Transitions are characterised by certain tasks being completed, relationships or attitudes developed or learning achieved (Bloom, 1985). Transitions also can be characterised by a discrete event(s) (e.g. being dropped, selected, going to university), these require the development of additional or different attributes or skills to facilitate these, often, traumatic moments, and research identifies several positive intervention strategies (Pearson and Petipas, 1990; Werthner and Orlick, 1986).

Tebbenham (1998) highlighted the importance of transitions in the UK sports environment. The move from junior to senior levels, increasing co-ordination problems between competitive and educational/vocational demands, and private relations are identified as key transitions; all these issues are recognised already from research in other countries (Hackfort

& Schlattman, 1994). Additionally in the UK, the move to university is a key transition because the support for elite athletes was lacking. This lack of support means that training and, often, competition is sought elsewhere, thus creating additional organisational difficulties such as time and financial problems for athletes. It also is apparent that 'sensitive' periods exist, when a young athlete may be more vulnerable to dropping out of sport or retiring early (Rowley, 1992). Such times are identified as immediately prior to or following examinations and after leaving school when they must decide on full-time employment or a full-time career in sport.

In relation to the present context, research on transition highlights how support and training requirements are likely to change throughout an athlete's development. Sometimes it appears that athletes require additional attributes to sustain development. For example, the ability to keep winning after initial high-level success is very problematic, and specific attributes are required to deal with the additional pressures that are created (Kreiner-Phillips & Orlick, 1993). Of course, such attributes can be taught in advance of any high level achievement to ensure a successful transition and ongoing success, but there is little doubt that the distinctive pressures of 'staying there' rather than 'getting there' (Gould et al 1993b; Kreiner-Phillips & Orlick, 1993) imply a need for separate, if linked, packages of skill development.

More problematic to the design of a developmental programme are the changing requirements of athlete support as an athlete progresses, as opposed to the additional requirements stressed by most performance plans. For example, coach behaviour may need to change from autocratic to democratic as the athlete develops. The problem lies in the need to recognise when a change requires to take place, and to deploy immediately a new optimum strategy. This recognition and understanding of key athletic transitions and the support required to ensure successful progress, must be combined within a flexible development programme to allow for individual requirements.

Transitions that can be targeted easily are those that involve a large number of athletes in similar ways. For example, entering University appears to provide similar problems for athletes, in many ways independent of sport. These can be recognised and dealt with consistently. Transitions that are harder to detect (and provide support for) require more individual attention. For example, being selected for a regional team may affect athletes differently, indeed either positively or negatively. Developmental programmes need to be able to recognise and deal with such individual issues to ensure successful TD.

6.4 Summary

Currently, TI processes within sport are empirically unsound, since resources are being targeted towards determinants of performance as opposed to the true determinants of potential; this may be an unfortunate result of the pressures faced by NGBs. Earlier sections emphasise that the key determinants of talent, initially at least, are psycho-behavioural. Even if an individual displays the key attributes however, their successful development still may depend on the complex interaction of attributes and the environment. In particular, the significance of the nature and structure of the training environment, as well as athlete support is discussed. Further, due to the coaching and support needs of novices and experts being disparate, the optimum coaching and support processes are dynamic. The unique developmental pathways taken by talented athletes further complicate the role of the environment.

SECTION 7: A THEORETICAL MODEL OF TALENT DEVELOPMENT – AND BEST FITS WITH PRACTICE

7.1 Bloom's Model of Staged Talent Development

It is important to recognise that relatively little research has addressed the ways in which elite athletes actually attain their status in sport (Tebbenham, 1998). Thus, for example, Regnier et al. (1993) present a review of talent detection and TD models developed over the past 25 years. However, although the area of TD is an intuitively seductive area, only limited research has been conducted in this area. Further, many investigations are limited due to insufficient detail about how talented performers progress to elite status. A particular exception, and one which is particularly crucial to the prior content and future purposes of this review, is Bloom's (1985) model of TD. Bloom's model utilises an holistic approach, incorporates transitions, and characterises the stages of development not by chronological age but by the completion of certain tasks, the development of relationships or attitudes or the achievement of learning. Interestingly and pertinently, the model was developed through structured interviews with Olympic swimmers and world-class tennis players, as well as non-sport talent such as neurosurgeons, concert pianists, sculptors and mathematicians. Figure 7.1 summarises the components of the model.

The model presents a useful and applicable series of stages through which excellence eventually is achieved:

Stage 1 Initiation	Stage 2 Development	Stage 3 Perfection
Performer	**Performer**	**Performer**
• Joyful • Playful • Excited • 'Special' • Fun/social oriented	• Hooked/committed • Potential identified • More serious • Task/achievement oriented	• Obsessed/dominates life • Personally responsible • Independent • Willingness to dedicate time and effort required for highest standards
Mentor	**Mentor**	**Mentor**
• Process centred • Kind/cheerful/caring • Notice child's 'giftedness'	• Superior technical knowledge • Strong personal interest • Respected • Strong guidance and discipline • Expected quality results	• Master coach • Feared/respected • Love/hate relationship • Successful/demanding
Parents	**Parents**	**Parents**
• Positive • Shared excitement • Supportive • Notice child's 'giftedness' • Sought mentors	• More moral and financial support (to maintain mentor relationship) • Restrict other activities • Concerned for holistic development	• Lesser role
General	**General**	**General**
• Little or no emphasis on competition	• Competition used as a yardstick for progress	• Fine tuning

Transition 1	Transition 2
• Development of an athletic identity • Accelerated development • Introduction to a more technical coach • Becoming more achievement oriented • Talent identification • Competition becomes yardstick of success • Increased commitment	• Prioritisation of sport in life • Psychological rebellion • Transition characterised by turning points perhaps stimulated by a successful performance/key event • Introduction of a master coach

Figure 7.1: Bloom's (1985) model of talent development

Stage 1 – Initiation

In this initial stage, Bloom notes that parents and mentors report that the child appears to have a level of giftedness. This giftedness affects both the expectations for the child and the methods of teaching, a process also observed by other researchers (e.g., Solomon et al. 1996). The teaching at this stage is not necessarily technical, but the coach is typically kind, cheerful and caring, whilst providing rewards for effort rather than for achievement. The parents are typically positive and supportive and share the excitement of the child's progress. The child itself is fun oriented, playful and excited. In the initial stage there is little or no emphasis placed on competition.

Stage 2 – Development

The transition to stage 2 is characterised by the development of an athletic identity by the performer; thus individuals realise that they were no longer children who swim, but rather they are swimmers, no longer children who play tennis but tennis players. They often undergo an accelerated period of development as they adjust to the second stage, and probably acquire much positive affective knowledge resulting from the intrinsic joy of progressive learning, as well as from enthusiastic support of both their family and mentor. According to Wall's (1986, cited in Regnier et al., 1993) terms, the child is acquiring the procedural and resultant affective knowledge base of skill acquisition. The performer is now hooked on their sport and takes it much more seriously. This 'development of commitment' is a significant step for the athlete, and is one of the major underlying components of excellence (Orlick, 2000). As a precursor to this stage, the performer's talent frequently is recognised in some way and the performer becomes much more task or achievement oriented. The new coach/new approach displays superior technical knowledge and discipline is enforced. Strong guidance is given and quality results are expected. The coach is well respected and develops a strong personal interest in the performer. It is at this stage that parents give more moral and financial support to cope with the increasing demands of the progression of their child. Parents also help by restricting outside activity, while still showing concern for the holistic development of the performer. Competition becomes the yardstick for measuring progress.

Stage 3 – Perfection

The transition to stage 3 is characterised by the increasing domination of sport over the performers' lives. A psychological rebellion is occurring as the performer begins to know about their own knowledge base (metacognitive knowledge; Wall, 1986, cited in Regnier et al., 1993), which reveals itself with a shift in the initiation of ideas from the mentor to the performer and a move to take personal responsibility for their own development. A change of coach also often marked this transition as a master coach was introduced. The obsession, independence and personal responsibility that is developed means that the performer is willing to put in the required time and effort to achieve the highest possible performance goals. While the role of the parents lessens, the relationship between the master coach and performer changes from respect to fear as higher and higher standards are demanded and performance is finely tuned. Often very strong emotional love/hate ties are created.

7.2 How Valid is Bloom's Model? – Support, Importance and Limitations

The most crucial aspect of this model relates to its subject pool. Bloom's model is based on performers' experiences of development, across the diverse areas of science (mathematicians

and neurologists), art (pianists and sculptors), and sport (swimming and tennis). Subsequent to his original investigations, support for the developmental pathway proposed by Bloom (1985) was provided by Scanlan, Ravizza and Stein (1989), who, having followed up Bloom's work, found comparable stages of development in 85% of the 26 former elite USA figure skaters. Three stages characterise the development of the elite figure skaters, with features such as increasing specialisation, commitment, financial demands and competition involvement offering a close fit to the progressions highlighted in Bloom's three-stage model.

The model, being based on performers' experience of their development to elite status, offers very rich data, describing cognitive, behavioural and social factors important and pertinent to elite athlete development. It also characterises the support needs of the performers and how these vary across time but in addition, and perhaps most importantly, it highlights the importance of transition, a fundamental aspect which is also emphasised in other more mainstream psychology areas such as life-span development (Hellstedt, 1995; Bee & Mitchell, 1984).

There are some limitations to this work however. For example, the population used to develop (Bloom, 1985) and support (Scanlan et al., 1989) Bloom's model were North American. The United States college system anchors the sport development system in the US and differs considerably to that in the UK, and differences in sport development systems and structures lead to disparate needs for the progressing athletes in these different cultures. Indeed, research by Moore et al., (1998) questions the applicability of Bloom's model in the UK by suggesting that there are no consistent patterns of discrete stages of development within or between UK sports.

Secondly, evidence for Bloom's model in athletics is only based on the progression of US athletes involved in individual sports (tennis and swimming). This may limit the extent to which the model is truly representative of development in team sports. Support for this concern is apparent in research showing that different pathways are evident between team and individual sports in the UK (Tebbenham, 1998). This study, which built on data from both TOYA and DOTS, questions the utility of a single model of TD to adequately represent athletic development in UK sport.

Another concern relates to the guidance that is offered for coaching athletes at the top level. Bloom suggests that the relationship between the master coach and athlete changes in the final stages from respect to fear as higher and higher standards are demanded, often with very strong emotional love/hate ties being created. It is at this stage, he suggests, that the performer becomes more independent and the initiation of ideas moves from the mentor to the athlete. Contrastingly however, research into motivation suggests that coaches of elite athletes should be encouraged to adopt a relatively democratic and positive style of coaching which emphasises personal development as well as the need to win (Weiss & Chaumeton, 1992). The confusing nature of coaching elite athletes is emphasised further through a study by Serpa, Pataco and Santos (1991) who show that democratic behaviour has the least emphasis placed upon it within elite sport teams. This disparity in coaching requirements at the top level is also emphasised by Tebbenham (1998), where evidence suggests that athletes in individual sports become more independent, but in team sports, there was no evidence at all for this change.

It is clear that the role of the coach at the top level is not certain and may depend on many factors including sport type, individual characteristics and culture. Apparent differences between team and individual sports also need to be recognised.

Specifically to the UK context, a further concern relates to the low numbers of 'master' coaches. Many performers in the UK regard themselves lucky to have a top coach, or said they had to change clubs or area to find good coaching (Moore et al., 1998). This is of concern when attempting to apply a model of TD such as Bloom's in the UK because of the emphasis that is placed on a master coach within the final stage of development. In addition, evidence from the TOYA study (Rowley, 1992), shows that inaccessibility to higher quality coaching for some athletes results in early retirement from their sport, an avoidable and sad waste of talent. Certain socio-environmental features of the final transition in Bloom's model include an increase in social restraint and added pressures of high-level sport. These additional demands may also be problematic; a key finding in the UK based TOYA study.

7.3 Multiple Developmental Pathways to Excellence

Bloom's model of development is appealing in many ways, one of which is its suggestion of a single generic developmental pathway to excellence. This concept appears unlikely however, especially in the light of Tebbenham's (1998) UK-based work on TD. Evidence from his qualitative study showed there to be no **one** pathway to excellence, either among or within sports. In fact, this concept of multiple routes to excellence is highlighted by Stevenson (1988), who found that both Canadian and British performers may take one of at least two routes as they socialise into elite level sport.

Despite the limitations of Bloom's generic model of TD, it has several strengths that highlight important factors that must be taken into account when designing future models of TD. Bloom highlights the importance of understanding that TD occurs as a process through different stages that are characterised by transitions, and his model gives a fairly in-depth and holistic explanation and description of each of the stages. Within each stage he includes parent, teacher and performer characteristics, and descriptions within each stage include behavioural, cognitive and social factors, highlighting characteristics required to acquire the necessary skills to progress. However, the implications of Bloom's model for the UK context requires further research into the developmental process of British athletes.

Whilst limitations are apparent in past research, many important features can still be used to analyse practical TID models.

7.4 Existing Applied Models of Talent Development and What is Needed

Due to the complexity of TD, in terms of the theory and methodology of talent training, several current practical TD models will be critiqued. Whilst some systems of TD seem more effective than others, it is likely that worthwhile ideas will come from a variety of models. Therefore, the following section will look at the positive and negative aspects of a wide scope of TD models from a variety of countries and sports, including Germany, Canada, Sweden, France and Britain. For clarity, the models are referred to, but described in more detail within panel inserts of the main text.

Models must accurately represent the athletic career

The British World Class (WC) model of TD (Figure 7.2) is based upon the structure of the Sports Council Continuum (Figure 7.3).

World Class Performance:	To assist our most talented individuals and teams improve their international rankings, placing in international competitions, and win more medals and championships.	
World Class Potential:	To support programmes that will develop our next generation of young sportswomen and sportsmen with the potential to achieve international status.	
World Class Start:	To support local sports development plans which provide the opportunities at school, community, and club level to enable all young people to participate in and improve their sporting skills; To identify and support young people with the talent and potential to progress; To ensure that there are sufficient resources, including skilled coaches, officials, administrators, voluntary leaders and teachers.	

(Cited from the English Sports Council World Class Potential Paper, 1997, p.3)

Figure 7.2: World Class Model for National Lottery Funding (adapted from Young People and Sport: Policy and Frameworks for Action, 1993)

- *Foundation* – learning basic movement skills and developing positive attitudes about physical activity.

- *Participation* – exercising one's leisure option and taking part in exercise for primarily fun, enjoyment, health and fitness reasons.

- *Performance* – striving to improve recognised talent through coaching, competition and training.

- *Excellence* – reaching national and publicly recognised standards of performance.

(Adapted from Young People and Sport: Policy and Frameworks for Action, (1993), p36-37)

Figure 7.3: The Sports Council Development Continuum (adapted from Young People and Sport: Policy and Frameworks for Action, 1993)

The three World Class support programmes are therefore closely associated with the top three successive stages of the continuum (Participation, Performance, Excellence). The WC model is simple and has a logical progressive nature. Consequently perhaps, it has proved useful to planners and administrators, and has anchored many Sports Council, Local Authority and National Governing Body of Sport (NGB) initiatives (e.g. the Youth Sport Trust, Champion Coaching, the Sport Science Education Programme). The model appears to provide the common structure for future support to developing athletes, ensuring a co-ordination of effort and resources to the athlete.

Crucially however, research has questioned the accuracy to which the WC model represents the athletic career in the UK (e.g., Tebbenham, 1998). In interviews, elite athletes were unable to distinguish between one stage and the next, but did not necessarily believe they had progressed through preceding stages to reach the top level. There was also confusion between the performance and excellence stages. This is a great concern for the model's use as a basis

on which to allocate funding and support services to athletes. Without an accurate picture of the needs of athletes, funding and support will be distributed in an ineffective and inappropriate way.

Another issue that is highlighted regarding the representation of TD models is the conceptual concern of presenting a single pathway to excellence. This simple concept is questioned in the UK with the suggestion that there are multiple pathways to excellence (e.g., Tebbenham, 1998; Stevenson, 1988). As mentioned earlier, Stevenson (1988) highlights that British and Canadian athletes may take one of two pathways. The first pathway involves a gradual attrition of other sports in which the athlete is involved. The second pathway involves the performer moving from a recreational to performance or achievement orientation in their chosen sport. Cooke's 'House of Sport' Model (Figure 7.4) is the only TD model that incorporates the concept of multiple pathways to excellence, although other limitations similar to the limitations of the WC model are apparent, such as undefined and non-specific stages with no incorporation of transitions.

Cultural differences also must be a consideration when devising TD models as both individuals and development structures can be vastly different between countries (Bloom, 1985; Tebbenham, 1998). Furthermore, there are currently no practical models of TD in the literature supported by empirical evidence. With the concerns highlighted above, providing research support for such models to ensure their efficacy is crucial.
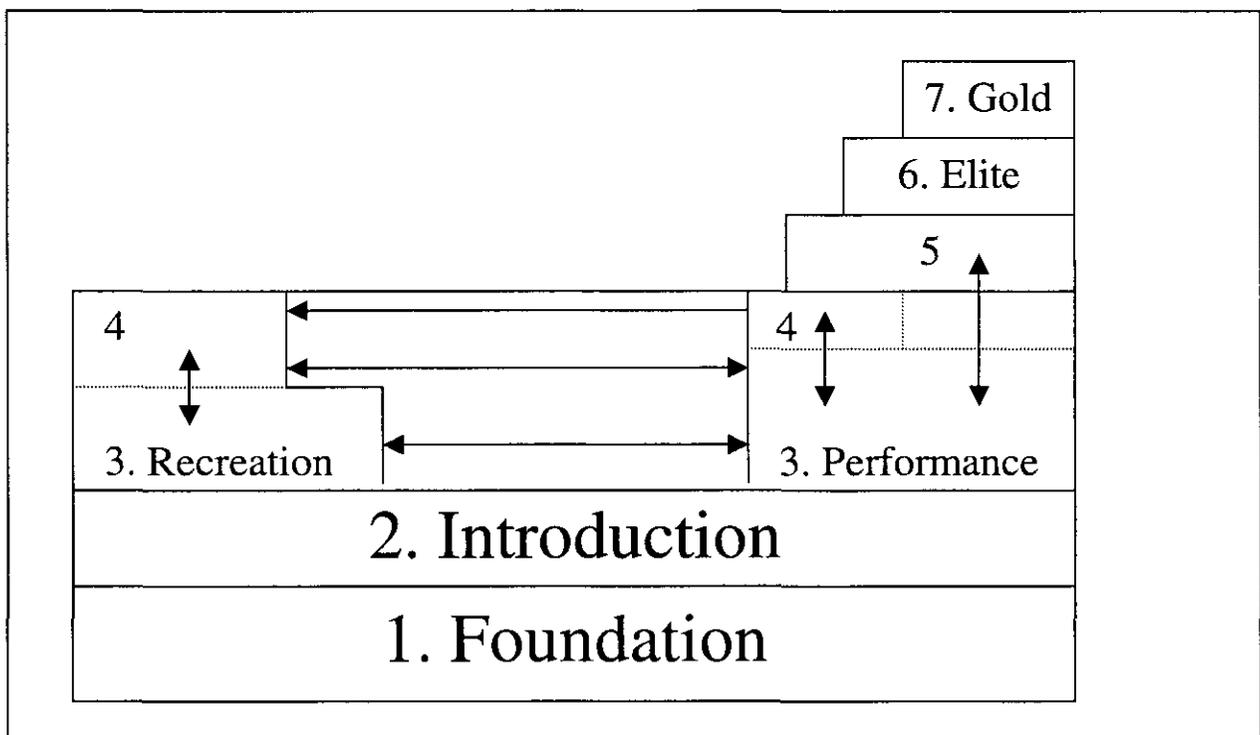
Figure 7.4: Geoff Cooke's ' House of Sport' Model of athletic development (Adapted from Cooke, 1997)

Research has highlighted the need to consider TD within an holistic development framework. The consideration of holistic development is apparent in some, but not all, models of TD. For example, a proposed model of TD in New Zealand (McClymont, 1999; Figure 7.5) emphasises that there also must be a strong commitment to the social and family support

systems, high quality coaching and quality education. The proposal attempts to avoid the wastage and duplication that presently exists, while utilising existing structures and processes.
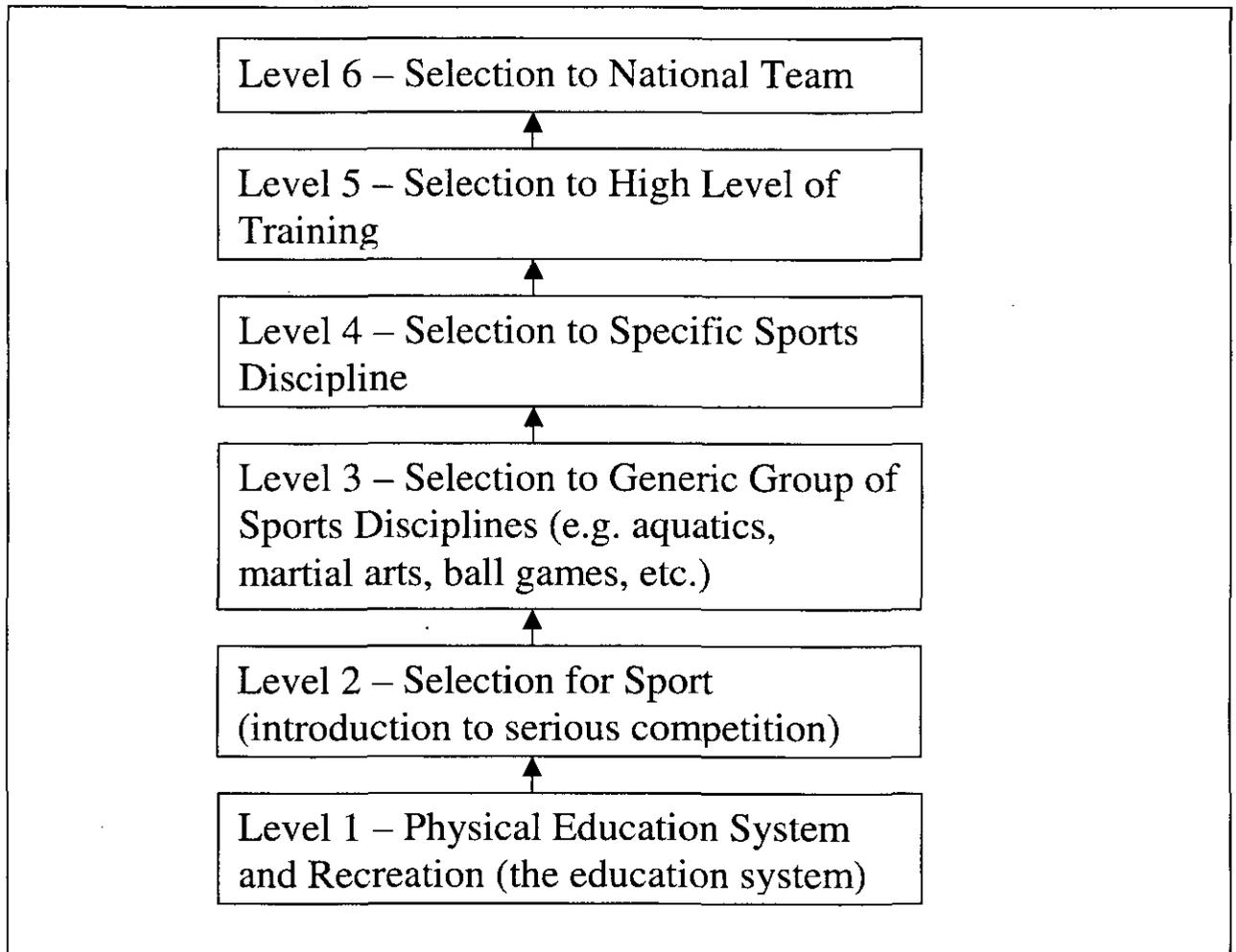
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┌─────────────────────────────────────────────────────┐
│                                                     │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 6 – Selection to National Team       │   │
│   └─────────────────────────────────────────────┘   │
│                        ▲                            │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 5 – Selection to High Level of       │   │
│   │  Training                                   │   │
│   └─────────────────────────────────────────────┘   │
│                        ▲                            │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 4 – Selection to Specific Sports     │   │
│   │  Discipline                                 │   │
│   └─────────────────────────────────────────────┘   │
│                        ▲                            │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 3 – Selection to Generic Group of    │   │
│   │  Sports Disciplines (e.g. aquatics,         │   │
│   │  martial arts, ball games, etc.)            │   │
│   └─────────────────────────────────────────────┘   │
│                        ▲                            │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 2 – Selection for Sport              │   │
│   │  (introduction to serious competition)      │   │
│   └─────────────────────────────────────────────┘   │
│                        ▲                            │
│   ┌─────────────────────────────────────────────┐   │
│   │  Level 1 – Physical Education System        │   │
│   │  and Recreation (the education system)      │   │
│   └─────────────────────────────────────────────┘   │
│                                                     │
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Figure 7.5: An Identification and Development Model for New Zealand (adapted from McClymont, 1999)

This is similar to the approaches by the Canadian sport schools, Football Association and Aston Villa FC schemes, and the system currently used in British trampolining. In similar fashion, the German model of TI takes a holistic approach by considering performance criteria, anthropometrical data, psychological characteristics of learning, skill development and social background. Some of these criteria have their limitations, nevertheless an holistic approach is utilised. In fact, the limitation to these models appears to be not the lack of holistic considerations but lack of detail as to how these holistic approaches are implemented successfully. Obviously more in-depth consideration of an holistic approach and methods needs to be presented in models of TD.

One model that incorporates a very individualistic holistic approach that would seem to be very beneficial for TD is the British Squash Prospects Management programme (Figure 7.6).
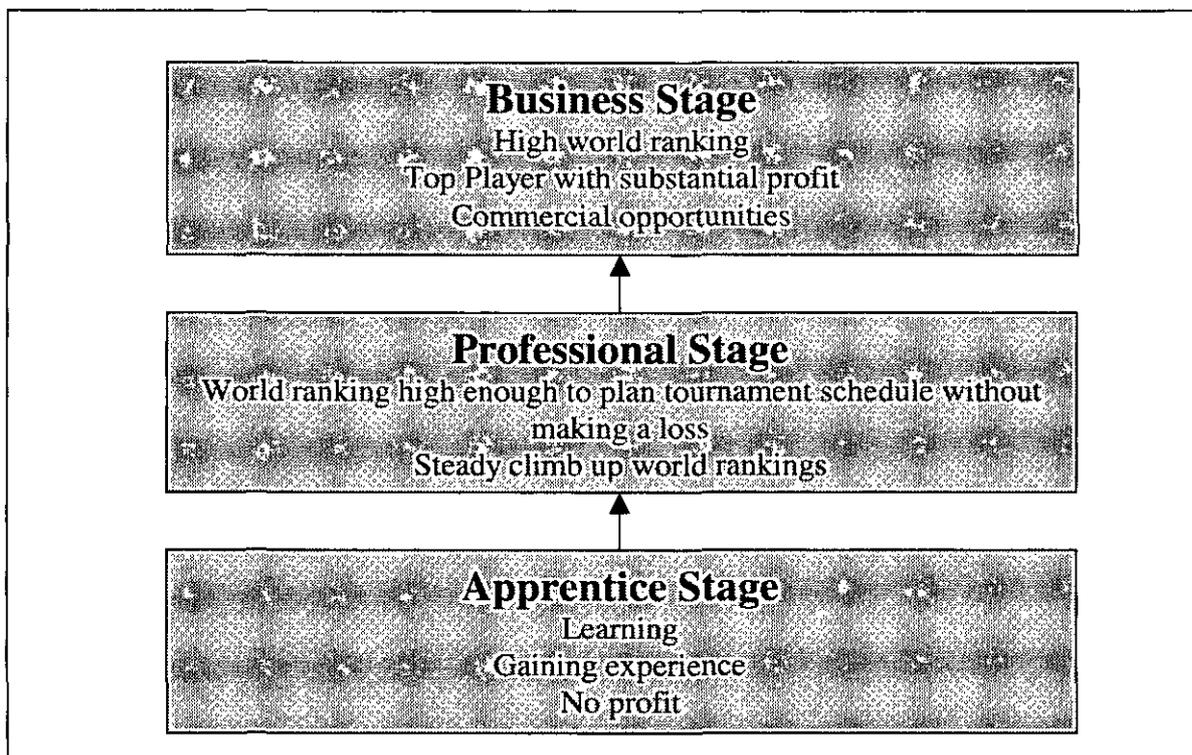
Figure 7.6: Prospects Squash Management process of development in Britain

The model initiates guidance of TD at a relatively late stage (i.e., when the athlete decides to make squash their living). However, despite this limitation, the model incorporates an holistic approach and in-depth support network including a sport psychologist, a sport scientist and researcher, a masseur, a physiotherapist and experts in diet and nutrition, physical fitness training, financial advice, marketing and promotion, and management consultancy. This range and depth of support appears to be very beneficial, with an emphasis on the individual that would appear to facilitate TD. Unfortunately, it also appears to be somewhat rare, at least in such a structured format.

Early development of generic skills

The importance of the development of generic skills is highlighted in the literature (e.g., Moore et al, 1998), but investigations from different parts of the world suggests that most young children do not receive the appropriate movement opportunities to develop adequate levels of basic motor ability (e.g., Reuchslein & Vogel, 1985; Ross & Gilbert, 1985). Unfortunately, this limitation also appears to be a factor that is rarely considered in TD models. The inclusion of generic training in the proposed New Zealand model of TD (McClymont, 1999, Figure 7.5) is a positive step, and 'Level 3' proposes advanced instruction in generic sport skills for the talented athletes who have shown an aptitude.

Even in this scheme, however, the selection of performers is limited to subjective opinion, while earlier TI comes before generic skills development. The situation is somewhat recovered however, since performers will remain in this group situation long enough to develop fully the universal skills of the generic area, before moving through the structure to national level and hopefully beyond. Hence, the strength of this system is the reduced risk of

children being 'locked' into a specific sport when greater potential lies elsewhere. An ongoing process of TI is another strong aspect of this model. The model also places emphasis on the use of accepted motor learning and control principles in the design of young performers' development regimes, rather than the more common 'tradition and habit' approach.

Years of Training	Training Phase	Squad	Support Institution	Coach	Training Contents
11-18	Top Performance training 1-2/day	A/B Squad (Federal Squad)	Olympic Support Centres Federal	Federal Coach, NGB coach, Support Centre Coach (full-time)	Perfection: Specific physical condition Tactical
8-10	Performance Training 4-5/week	C-Squad (Federal Squad)	Support Centres Federal Training Centres	Support Centre Coach (full & part time)	Abilities Technical skills Mental skills
5-7	Build-up training 3-4/week	D/C-Squad D4 Squad (Regional Squad)	Regional (State) Training Centres Talent	Regional (State) coach (fulltime)	Develop & improve: General & Specific physical condition Tactical
2-4	Basic Training 2-3/week	D-squad	Promotion Groups in Clubs or Talent Centres	Club Coach (mostly fee contact)	Abilities Technical skills Mental skills
1	Initial Training 1-2/week	Talent Identific-ation	School Club	PE teacher Instructor	Develop: Co-ordination Abilities Movement Variability

Figure 7.7: The education and development scheme of the progression for young athletes in Germany (Adapted from Kozel, 1996).

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The German model of TD (Figure 7.7) is another model that incorporates the early development of basic skills (co-ordination, movement variability and general physical condition), and delays specialisation for as long as possible. It is highlighted that these features are developed and utilised in practical settings in joint programmes, such as that in the federal state of North Rhine. The model can be considered a frame of reference for a number of different sports federations. The British LTA model of TD (Figures 7.8 & 7.9) also incorporates a variety of activities into the training schedule, which would aid in the development of a wider range of skills. The development of general co-ordination and tennis specific co-ordination occurs before the age of 12. A varied and prolonged sport involvement is continued right through to age 18. The LTA has developed suggested training volumes for specific ages and how these can be broken down into specific and general training.

Age	Sessions per Week	Hours per week	Days per week	Months per year	Athlete training	Tennis training & competition
5-6	2-3	2-4	2-3	5-7	60%	40%
7-8	3-5	4-6.5	3-5	6-8	55%	45%
9-10	5-7	7-11	4-5	8-9	50%	50%
11-12	8-9	11-14	5-6	9-10	45%	55%
13-14	9-12	12-18	5-6	10	40%	60%
15-16	12-15	15.5-22.5	5-6	10-11	40%	60%
17-18	13-18	19.5-27	6	11	40%	60%

Figure 7.8: Suggested training volumes for developing British tennis players (LTA)

Age	Other Sport	Tennis Fitness	Tennis Training	Matches
5-6	35%	25%	39%	1% (4-10)
7-8	35%	20%	40%	5% (8-15)
9-10	30%	20%	40%	10% (40)
11-12	15%	30%	40%	15% (50)
13-14	5%	35%	40%	20% (60-80)
15-16	5%	35%	40%	20% (70-90)
17-18	5%	35%	40%	20% (90+)

Figure 7.9: Suggested breakdown of training type during British tennis development (LTA)

Interestingly, the World Class (WC) model of TD promotes "the development of basic movement skills and positive attitudes towards physical activity" at the foundation level before any TI process begins. Unfortunately, there is no incorporation of what, when or how (and no evidence for even if!) this is implemented, and research also suggests that there is still concern of the nature and quality of movement skills of young children in the UK (Moore et al., 1998). It must be highlighted that sports such as gymnastics emphasise the development of basic movement skills before any specialisation is attempted at all. It is apparent that children who have been to gymnastics or dance prior to other sport involvement tend to develop skills quite quickly because fundamental skills, such as balance, have already been developed (Moore et al., 1998). Thus, this should be a beneficial aspect of any TD model, but should surely be insisted on as normal practice since all would benefit from such an approach. Figure 7.10 highlights the recommended training volume in British gymnasts.

Age (Years)	Recommended Training Hours per week (max)
5 – 7	8 hours
7 – 9	8 – 10 hours
9 – 11	10 – 14 hours
11 – 14	15 – 20 hours
14 – 16	20 – 24 hours

Figure 7.10: Recommended training volume in British gymnastics

In the early stages of programming, children's time should be split into 70% physical preparation and 30% technical. The physical component of training never falls below 30% of the training time at any age. There are no organised gymnastic competitions for children under the age of eight. Even at this age, there should only be one competitive phase per year and it should be relatively short. Only when children reach the age of 10 or 12 should two competition phases be introduced. There is a high emphasis put on the early development of good generic skills. Also, in the early stages, a high emphasis is placed on developing psychological characteristics of skill acquisition such as intrinsic motivation.

The introduction of mini games for young children (e.g., rugby union) is an additional concern (Figure 7.11). Although mini games encourage early participation in physical activities and as such provide many benefits, they introduce specialised skill development even earlier into childhood, potentially at the expense of generic skills that are fundamental to the development of excellence across sport. Strong central guidance would appear to be the minimum requirement of the funding agencies.
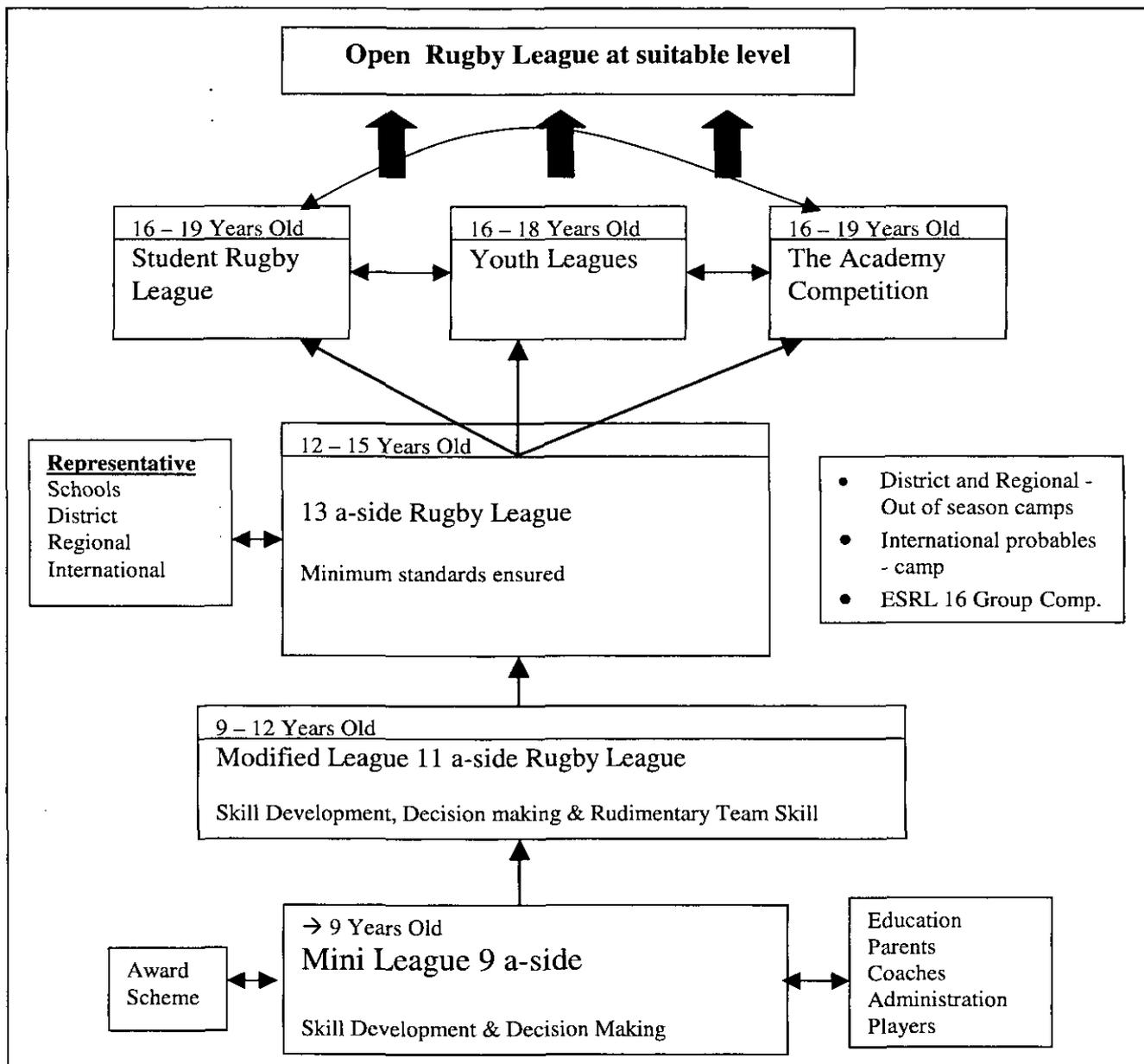
Open Rugby League at suitable level

16 – 19 Years Old	16 – 18 Years Old	16 – 19 Years Old
Student Rugby League	Youth Leagues	The Academy Competition

Representative
Schools
District
Regional
International

12 – 15 Years Old

13 a-side Rugby League

Minimum standards ensured

- District and Regional - Out of season camps
- International probables - camp
- ESRL 16 Group Comp.

9 – 12 Years Old
Modified League 11 a-side Rugby League

Skill Development, Decision making & Rudimentary Team Skill

→ 9 Years Old
Mini League 9 a-side

Skill Development & Decision Making

Award Scheme

Education
Parents
Coaches
Administration
Players

Figure 7.11: A model of talent development in British rugby league

Incorporation of transitions

Transitions are identified as a major characteristic of TD in the UK (Tebbenham, 1998), and recognised as central features of other, more substantial, models of TD (Bloom, 1985; Scanlan et al., 1989). Sinclair & Orlick (1993) also highlight that successful transitions can affect future success. Accordingly, several intervention models have been developed to aid transitions (Danish, Petipas, & Hale, 1992; Pearson & Petitpas, 1990; Blann, 1992). Unfortunately, even though such research exists, there is little research on transitions in the UK, and crucially, no practical models of TD incorporate the notion of transitions within their models.

Chronological age

Unfortunately, many models of TD still incorporate stages of development that are characterised by chronological age. The British squash model of TD, the German model, New Zealand model and WC model of TD are exceptions. Even these models are lacking however, and nearly every model of TD identifies each stage of development with insufficient details regarding the athlete characteristics that need to be developed at each stage, the methods required to develop those characteristics and the support required.

Psychological characteristics of skill acquisition

Positive aspects of some TD models (e.g. German, British Squash – Prospects Squash Management system, and British trampolining) include the early and continued development and recognition of some psychological characteristics that support and facilitate the skill acquisition process that forms the essential core of any TD process. Models of TD now need to take this a step further, and define the skills and characteristics that are required at each stage as well as the methods and support networks required to facilitate their development. Also, anticipating the needs of the elite performance level, the skills, physical and psychological characteristics of performance and psychological characteristics of 'staying there' need to be identified along with the methods and support networks needed to develop them.

Talent identification and development in Scottish sport

The Scottish Sports Council's document Sport 21 'Nothing left to chance', a strategy for Scottish sport, highlights the intrinsic nature of sport to Scotland's culture and sense of pride, also emphasising the importance of its unique contribution to Scottish society. Indeed whilst there are many generic factors that can be utilised to help optimise talent detection and identification procedures, research illustrates the importance of recognising and acknowledging specific contexts. Consequently, this section considers TID policies within Scotland.

> *'Traditionally within Scotland the individual in sport endeavours to find a pathway, usually progressive in nature, that will lead her/him to a level of participation that will satisfy their own desire and aptitude.'*
> (Randak, 1998)

The holistic view of sports participation and development within Scotland is co-ordinated and facilitated through the Sports Council's, sports development model (Figure 7.12). Randak (1998) recognises the simplistic and convenient nature of the Sports Development Continuum. However, Randak also highlights that the continuum provides a logical progressive basis for NGBs, local authorities, and other organisations to address identified and perceived areas of responsibility in sport development.
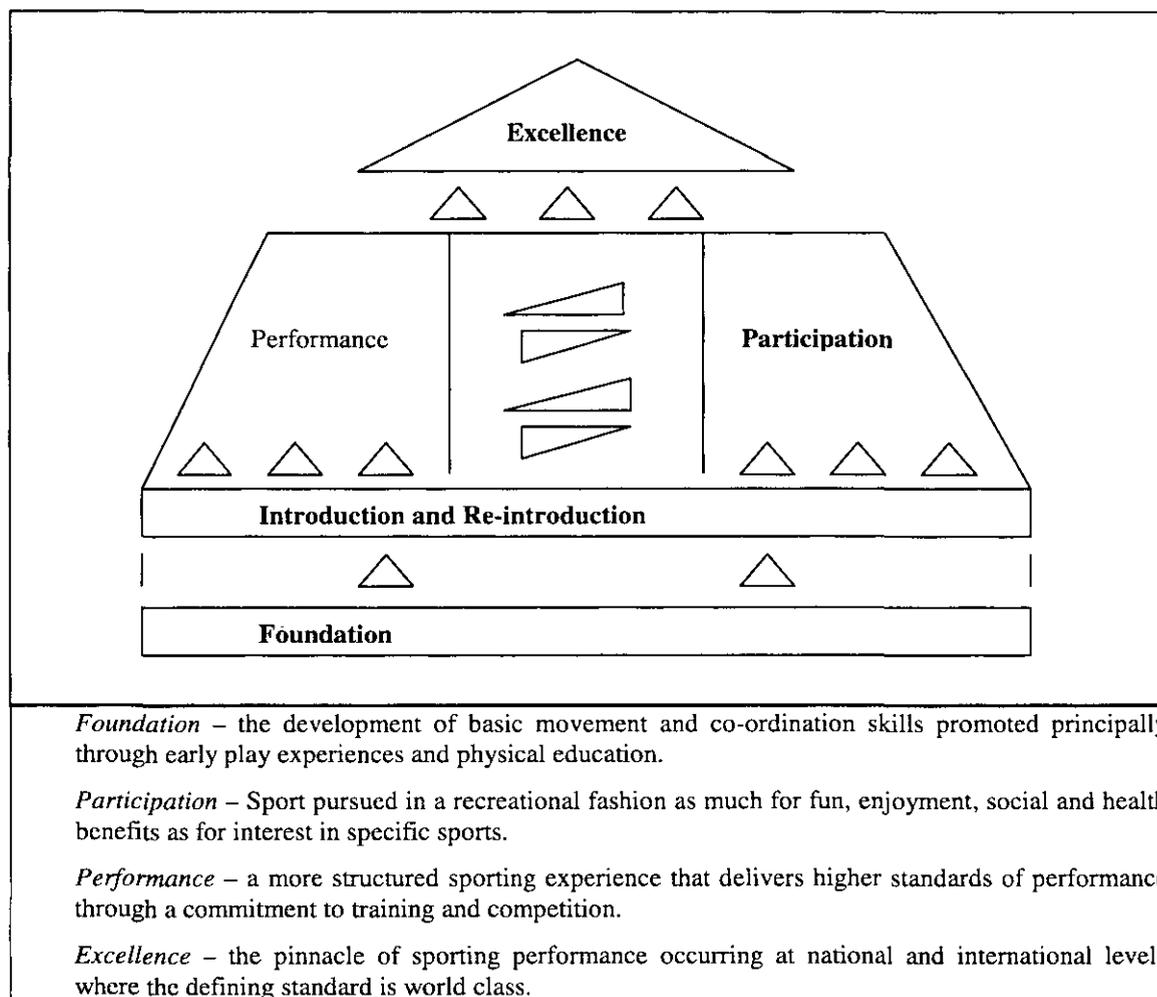
Foundation – the development of basic movement and co-ordination skills promoted principally through early play experiences and physical education.

Participation – Sport pursued in a recreational fashion as much for fun, enjoyment, social and health benefits as for interest in specific sports.

Performance – a more structured sporting experience that delivers higher standards of performance through a commitment to training and competition.

Excellence – the pinnacle of sporting performance occurring at national and international levels where the defining standard is world class.

Figure 7.12 The Sports Development Continuum (Randak, 1998)

The efficient co-ordination of efforts and resource allocation is vital to the efficacy of any sport development model, but importantly, the structure guiding this support must be sensitive to the real needs of the athletes if it is to be truly effective. Supporting TD models with empirical evidence is crucial if optimum resource allocation is to be achieved (Tebbenham, 1998). Evidence from this academic review raises issues concerning the ability of the 'World Class model of Talent Development' and the 'Sports Council Development Continuum' (The Sports Council, 1993) to allocate effectively resources to support developing athletes. Tebbenham (1998) highlighted that current UK models do not accurately represent the development pathway in sport or acknowledge the transitions that UK athletes progress through.

Encouragingly, in a similar fashion to Cooke's (1997) 'House of Sport Model', the Scottish Sport Development Continuum (Figure 7.12) incorporates two pathways to excellence. However, the model does not acknowledge the transitions that are so significant for successful progression in sport (Tebbenham, 1998; Sinclair & Orlick, 1993). Unfortunately, the stages within the model are undefined and non-specific, analogous to many simplistic TD models. To ensure the effective allocation of effort and resources, research that identifies transitions and the associated needs of UK and Scottish athletes is recommended.

The two principal approaches used by governing bodies in the UK for TI and development is 'natural' progression through age level competition and developmentally oriented approaches

that span age group barriers. However, as Randak (1998) recognises, "many young people do not play within governing body structures and are therefore lost to progression" (p.50). The advantage of employing developmental pathways that include partnership initiatives with schools and local authorities is apparent. These partnership initiatives will foster the provision of support for all athletes regardless of the developmental pathway being pursued and help limit the likelihood of talent being lost. Positively, many of these points are highlighted as part of Scotland's recent developmental policy, Sport 21 (Scottish Sports Council, 1998).

Sport 21

Sport 21 (Scottish Sports Council, 1998) is a strategy for Scotland which aims to make sport more widely available to everybody, recognise and nurture sporting talent, and achieve and sustain world-class performance in sport. As with the World Class model of TD, (1993, see figure 7.2) there are four main stages within Sport 21 (as depicted in Figure 7.12), and as such, the limitations discussed earlier clearly apply. In brief these were:

- A developmental structure that is unsupported by empirical evidence and likely to result in inappropriate allocation of resources.
- UK athletes have been found to develop through a number of key transitions and effective support during these transitions is crucial to future success of the athlete (Moore et al., 1998). Unfortunately, Sport 21 does not acknowledge these developmental transitions.
- The four main stages within Sport 21 are undefined and non-specific. Therefore, there is no guarantee of consistent understanding and practice throughout Scotland.

Nevertheless, Sport 21 recognises the need to improve links, co-operation and co-ordination between schools, universities, clubs, regional and national squad structures. The importance of ensuring time, energy and finance are directed at the club development is also highlighted. These processes will help provide a structure that can facilitate the development of every athlete within Scotland. However, optimum systems of support are not explicit. Optimum support networks need to be recognised and defined at each stage of progression to ensure effective progress for all athletes. For example, Bloom (1985) suggests that as an athlete develops an athletic identity (i.e. they become a swimmer, not a child who swims), they progress from an 'initiation' to a 'development' stage. This change also brings a shift in the optimal developmental environment needed; the athlete requires greater emphasis on technical coaching in an increased task, as opposed to social, oriented setting.

As well as the proposed improvement in the sport developmental structure within Scotland, an additional aim of Sport 21 is to increase facilities and promote the development of 'basic movement and co-ordination skills' through a minimum of two hours of physical education per week to every Scottish primary school. Borms (1994) highlighted physical education in schools as one of the key foundations of a successful system of sport in any country. Recently, Wright, Webb, Rowland, Vialle and Wilsmore (2000) highlighted how "sport participation levels can be enhanced when there is a concerted and co-ordinated effort on the part of schools, and community sporting organisations" (p.10). The emphasis on basic movement and co-ordination skills within Sport 21 is clearly a positive feature. The significance of these skills to both physical-activity participation and sport performance has been highlighted within Section 2.3. For example, developmental research shows that if life-long participation is to be increased, then it is imperative that fundamental movement skills are taught to children at an early age (Jess, 1999). This will ensure that the skills underpinning

<u>all</u> sports specific games are learnt early, allowing children to participate freely and confidently in a range of sports.

> *Children who possess inadequate motor skills are often relegated to a life of exclusion from organised and free play experiences of their peers, and subsequently, to a lifetime of inactivity because of their frustrations in early movement behaviour.*
>
> Seefeldt et al. (1979, cited in Jess, 1999, p.1)

Additionally, the development of a generic skill base allows the successful transition from participation in one sport to another. In further support of the need to develop fundamental movement skills, research has found that many successful elite athletes begin their sporting career in a different sport to the one in which they end up excelling (Moore et al. 1998). However, it must be recognised that the structure of the two hours of physical education is of <u>crucial</u> importance in deciding the extent of any benefits gained. Unfortunately, generic skills are often confused with involvement in a wide range of sport specific skills. Traditionally, physical education is based on team sports since they are appropriate for group teaching. However, team sports only develop a range of <u>sport specific skills</u> as opposed to fundamental skills that underpin <u>all</u> sports. Additionally, our review of literature has clearly established the role of psychological characteristics to both skill acquisition and performance; factors not considered within the Sport 21 model.

sportscotland's Talented Athlete Programme

sportscotland's Scotland's Talented Athlete Programme (TAP) aims to provide financial support to top performers and athletes who have the potential to perform at the highest level. Applications for funding are assessed on several criteria including eligibility, performance, targets, future potential, value for money, quantity and quality of proposed programme, current performance standard, relevance to existing national strategies, and financial need. The programme also provides subsistence awards that are given to the highest standard performers. It is important that the limited financial support available for sportsmen and sportswomen in Scotland is directed in the most effective means possible. The issues presented earlier regarding the need to distinguish between performance levels and potential to excel at the senior level within any TID models apply here. Although 'future potential' is included in the assessment of athletes, there is no additional information regarding its criteria and how it is distinguished from performance. Indeed, the provision of subsistence awards is based exclusively on the performance levels of athletes.

7.5 Summary

Models of TD have been critiqued in light of the research on TI processes. These TD models are crucial since they serve to guide the allocation of funds, resources and support to athletes, whilst the content within the model provides a coherent, consistent basis for the development of talent. Although there are gaps in the research and many questions are still unanswered, several characteristics of effective models can be identified and, most crucially, justified on both empirical and practical grounds. Accordingly, a summary presents the issues that have been raised by the critique of the literature on TD, which may serve as an 'aide memoire' for the design of a new, more comprehensive and effective scheme.

A possible evaluative framework would address the following issues.

1. Does the model take an holistic approach to TD, incorporating holistic environmental influences on the athlete's development but also consideration for the holistic development of the athlete themselves?

2. Is the model representative of the athletic career? Is it supported with research evidence? Is the model inclusive of key transitions and appropriate pathways to excellence?

3. Does the model incorporate early generic skills development and delayed specialisation?

4. Is the TI process combined with the TD process to ensure an ongoing identification process that begins after prior generic skills development?

5. Are stages characterised by certain tasks being complete, relationships or attitudes developed, by learning achieved, or by a discrete event(s), **BUT NOT** by chronological age?

6. Are the stages defined with the skills and psychological characteristics of the skill acquisition process that are required at each stage as well as the methods and support networks required to facilitate their development?

7. Are the stages at the elite performance level, as defined by the skills, physical and psychological characteristics of performance and psychological aspects of 'staying there' identified together with the methods and support networks needed to develop them?

SECTION 8: SUMMARY OF CONCLUSIONS AND IMPLICATIONS

Within this final section, only brief summaries of the conclusions and implications that have emerged clearly from the review are presented. Consequently, this final section will suggest a future direction for effective TID schemes, particularly in a Scottish context. Three major areas of concern for those individuals involved in the identification and development of sporting talent are summarised below.

8.1. Research

As the review has shown, to date at least, research into TD and the direction of talent detection and identification systems has been somewhat orthogonal. Thus researchers, driven by the professional interest to achieve publications, have confined themselves largely to relatively simplistic uni-dimensional examinations. In the future, multi-factor longitudinal studies must become the norm, with an inter-disciplinary approach essential in order to cater for the known interactions that occur in a multiplicative manner. In a similar fashion, need rather than rational thinking has driven the direction of talent detection and identification schemes. Indeed, it is arguable whether the pressures of World Class Performance plans, the need for ego reinforcement, and the results-based mentality, mean that no true talent detection and identification schemes currently exist in Britain. In the present regard, however, talent detection and identification schemes must be designed, evaluated and refined based on empirical research rather than intuition or immediate need. Consequently, ongoing longitudinal research that tracks a number of youngsters to a number of factors would appear to be required. In short, TOYA, with a much wider focus, needs to be completed.

8.2 Funding and Direction of Talent Detection and Identification Schemes

As intimated earlier, it is doubtful whether a 'true' talent detection and identification scheme currently exists in Britain. The focus on current performance rather than potential, which typifies talent detection and identification, is paralleled by the need for successful youth squads that drives the development agenda. Therefore, based on empirical research, agencies need to redirect their performance outcomes towards a more developmental and potential building agenda. In other words, TI and TD should be combined processes that emphasise direction and development instead of the traditional practice of selection and elimination.

8.3 Potential Outcomes of Talent Detection/Identification and Development Schemes

The duality of goals for such schemes is easily apparent. Seen originally as a means of improving British sporting achievements, TID must now serve a second agenda of equipping and empowering youngsters for a lifetime of greater physical activity.

However, although many in performance sport may rankle at this highjacking, in fact the aims and methods for this twin track approach, can sit comfortably together, and indeed, offer a considerable amount of cross-pollination. For the long-term health of TID, and indeed for the long-term health of the nation, for both elite sport and "normals", TD systems should be focused on an early development of motor capacity. This work would enable a wide variety of outcomes including true potential building for performance sport, a contribution towards raising physical activity levels in youngsters and identification/initial rehabilitation for those with mild motor impairment. Subsequent to this, but not too long afterwards, the development of a psychological "excellence profile" would help to equip youngsters for future challenge in whatever domain. In fact, this would seem to fit well with the Government's current initiatives in complex constructs such as citizenship.

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