CHAPTER FIVE

TALENT IDENTIFICATION: PSYCHOLOGICAL PERSPECTIVES

5.1   INTRODUCTION

The multi-factorial and multi-dimensional nature of sport and rugby, with the associated requirements of excellence within these factors and dimensions has been widely documented (Ericsson & Lehmann, 1996; Brown, 2001; Krüger *et al.,* 2001; Olds, 2001; Nieuwenhuis *et al.,* 2002; Janelle & Hillman, 2003; Elferink-Gemser *et al.,* 2004, 2007; Abbott *et al.,* 2005, 2007; Vaeyens *et al.,* 2006; Ollis *et al.,* 2006; Andrew *et al.,* 2007) both in literature, and in previous chapters, with the physical and developmental aspects of these perspectives reviewed in-depth in chapter four of this study.

Due to this strong consensus that psychological factors and dimensions, in conjunction with the physical factors and aspects of sport and rugby, are of immense value to talented and superior performance in these afore-mentioned endeavours, it is found that these factors and dimensions are, or need to be, increasingly incorporated into talent identification and development protocols and initiatives (Régnier *et al.,* 1993; Hare, 1999; Brown, 2001; Abbott & Collins, 2002, 2004; Abbott & Easson, 2002; Nieuwenhuis *et al.,* 2002; Falk *et al.,* 2004; Abbott *et al.,* 2005, 2007; Lidor *et al.,* 2005, 2007; Button & Abbott, 2007; Elferink-Gemser *et al.,* 2007) to properly adopt a multidisciplinary, multivariate approach to talent identification and development.

It was pointed out in chapter three that in recent times there has been a recognised increase in research into issues of excellence in sport (Starkes *et al.,* 2001; Starkes & Ericsson, 2003; Williams *et al.,* 2003; Abernethy *et al.,* 2005; Williams & Ericsson, 2005; Williams & Hodges, 2005; Hodges *et al.,* 2006; McPherson & Kernodle, 2007; Vaeyens *et al.,* 2007), with an associated increase in calls for the adoption of a multidimensional and multidisciplinary approach (Wrisberg, 1993, 2001; Ward &

Williams, 2003) to the study of expertise and excellence, as well as other related considerations in sport. This increased interest in sporting excellence from a research perspective is confirmed by the parallel increase in focus on issues of excellence in sport from the unique and evolving discipline of sport psychology and the related perceptual-cognitive and perceptual-motor perspectives.

There is a slew of books, volumes, (Singer *et al.,* 1993, 2001; Cox, 1994; Roberts, 2001a; Starkes & Ericsson, 2003; Weinberg & Gould, 2003; Williams & Hodges, 2004; Ericsson *et al.,* 2006; Tenenbaum & Eklund, 2007) texts and studies (Helsen & Starkes, 1999; Gould *et al.,* 2002; Williams *et al.,* 2003; 2004; Abbott & Collins, 2004; Abernethy *et al.,* 2005; Williams, 2005; Williams & Ericsson, 2005; Smith, 2006b; Williams & Ward, 2007) that serve as evidence of this fact.

Therefore it is an accepted and widely researched fact that certain psychological skills, abilities and attributes are needed, used and/or possessed by performers in achieving high levels of performance in elite sport and rugby, as the literature included shows (Potgieter, 1992; Cox & Yoo, 1995; Spamer, 1999; Morris, 2000; Williams & Reilly, 2000b; Brown, 2001; Fourie & Potgieter, 2001; Olds, 2001; Abbott & Collins, 2004; Abbott & Easson, 2002; Gould *et al.,* 2002; Hale & Collins, 2002; Jones *et al.,* 2002, 2007; Williams *et al.,* 2003, 2004; Baker & Horton, 2004; Golby & Sheard, 2004; Abernethy *et al.,* 2005; Nordin *et al.,* 2006; Andrew *et al.,* 2007; Williams & Ward, 2007).

In keeping with the recent trend of increasing multidisciplinary research into sport, and as noted at the start of this chapter, there has of late been an upswing in the number of studies and publications calling for the consideration, as well as actually including these factors alongside the physical aspects, when selecting teams or players, or when performing talent identification and development (Brown, 2001; Abbott & Collins, 2002, 2004; Abbott & Easson, 2002; Nieuwenhuis *et al.,* 2002; Falk *et al.,* 2004; Abbott *et al.,* 2005, 2007; Lidor *et al.,* 2005, 2007; Andrew *et al.,* 2007; Button & Abbott, 2007; Elferink-Gemser *et al.,* 2007), although the importance of

psychology in talent development, and the inclusion of tests for psychological variables in talent identification protocols has been noted, suggested and performed in literature (Régnier *et al.,* 1993; Hare, 1999) for some time already.

In fact, it has been suggested by some that psychological skills and abilities are not only of tremendous importance in sport, but that these aspects are, in certain instances, of greater significance and can serve as better predictors of success (Abbot & Collins, 2004; Nordin *et al.,* 2006) or, in conjunction with technical abilities and skills, act as more effective discriminators between more able and less able players (Williams & Reilly, 2000b; Williams & Ward, 2007), than physical, physiological and anthropometrical variables. Abbott and Easson (2002) and Andrew *et al.* (2007) concur that psychological factors are important in identification and selection respectively, and that an integrated approach toward these respective endeavours is needed.

Therefore, it is clear that mental and psychological faculties, skills, attributes and abilities are absolute prerequisites for success in sport and that furthermore, analyses and possible measurement of these faculties, skills, attributes and abilities is important in the process of talent identification if this process is to be all-encompassing and successful in achieving its goal of attaining the highest prediction accuracy as is possible.

5.1.1   Background of sport psychology

The field of sport psychology and the associated interest therein has expanded considerably in recent times (Singer *et al.,* 2001; Weinberg & Gould, 2003; Williams, 2005; Smith, 2006b; McPherson & Kernodle, 2007). Interest in and the development of the parent discipline of psychology is certainly not a contemporary occurrence, however. The earliest psychological concepts were apparent from the time of Plato (427 to 347 B.C.) and Aristotle (384-322 B.C.). It is a discipline that has as its origin the striving of man to make sense of the mind-body relationship. Since then, psychological concepts have constantly evolved in step with an ever advancing

human kind, but it was the influence of Wilhelm Wundt in 1879 that is regarded as the date of psychology's beginning (Jordaan & Jordaan, 1984, 1998).

Sport psychology, however, is often mistakenly referred to as being a young area of study (Weinberg & Gould, 2003), but, the earliest work can in fact be traced back to the end of the 1800's with Norman Triplett widely regarded as the original groundbreaker in this field. But, the 1960's and 1970's are widely associated as being the era of this discipline's historical emergence and the start of its rise in prominence (Singer *et al.,* 2001; Weinberg & Gould, 2003; Wuest & Bucher, 2006).

Since sport psychology is so intimately linked to the main discipline of psychology, it stands to reason that sport psychology would be directly influenced by the general developments and trends in psychology. This chapter serves to highlight not only the main trends and approaches in the study of excellence in sport from the perspective of sport psychology, but also the major findings, theories and conclusions.

5.1.2 Chapter outline

As noted, a number of studies and texts emphasise the different psychological aspects and skills needed to reach elite levels of sport representation. One very helpful study that assigns these aspects and skills into two specific categories is the study of Baker and Horton (2004). They provide this very helpful distinction as to the psychological characteristics of excellence and expert performance in sport when they state that *"…there are common mental characteristics essential to high levels of performance in any sport. Furthermore, these factors can be divided into characteristics necessary for the acquisition of expertise and those necessary for the manifestation (i.e., the demonstration) of expertise"* (Baker & Horton, 2004:216).

This chapter is very much informed by these sentiments and provides a discussion that focuses on 1) the psychological and mental attributes required to *achieve* elite level in sport and rugby, as well as 2) the psychological and mental attributes and

(psychomotor) skills that are required to *demonstrate* superior abilities within elite sport and rugby. There are some minor differences, however, in this study's interpretation and further elaboration of the psychological skills and attributes needed for the achievement and demonstration of superior abilities, and the original interpretations of Baker and Horton's (2004). But, valuable guidance has been garnered from their work and aspects such as motivation and others are certainly common ground, as is shown throughout.

Section one: motivation, commitment and practice

In sub-section one of this chapter, the psychological and mental attributes and practices needed to achieve elite levels in sport and rugby are reviewed. This involves the concepts of motivation and commitment. The evidence presented from literature is unanimous that these attributes are the overriding considerations pertaining to the achievement of high levels of performance.

Furthermore, in this sub-section the concept of practice in the form of the Theory of Deliberate Practice of Ericsson *et al.* (1993) is briefly reviewed. While this theory was analysed in-depth in chapter four, this review of the theory has been included in this section for the sole the fact that practice can be regarded as the proverbial "golden thread" that runs through high ability and achievement in all domains, most notably sport. Pertinent to its inclusion in this sub-section are the constructs of motivation and the (lack of) enjoyment that this theory highlights as role-players and constraints in the sustenance of participation in deliberate and focused practice.

Section two: perceptual-cognitive and perceptual-motor skills

The second sub-section of this chapter deals with the psychological and mental (psychomotor) skills and abilities necessary for the demonstration of excellence or high levels of performance in elite sport and rugby. These include perceptual-cognitive abilities and skills and how these are needed to attain the requisite levels of excellence within a sport. Perceptual-cognitive skills and abilities include those of decision-making, response selection, experience, memory and others that are

traditionally factors that come under consideration in the studies of excellence and expert performance in sport.

Also highlighted is the very recent trend (in sporting terms) instigated by the move away from mere cognitive explanations for excellence in sport (rugby) toward the conviction, arising from the ecological psychology and dynamical systems theories, that "cognition free" perceptual-motor abilities and skills are responsible for excellence and elite performance in sport.

Section three: mental toughness
Recent literature highlights factors such as emotional strength and control as being needed for excellence in sport. These and other issues such as self confidence, the control of anxiety, focus and the like are critical for success in elite sport. These factors have been reviewed in this sub-section under the general construct of mental toughness and strength.

Section four: summary and application to talent identification and development
In the final sub-section of the chapter, a summary of the preceding discussion is provided followed by a discussion of three important issues.

1) The interrelation of the psychological and mental skills, attributes and abilities mentioned in this chapter. In particular the relevant and possible influence that these skills and abilities have on one another as well as on talent identification and development will be reviewed.

2) A review of the possible incorporation of the Mental Toughness Framework of Jones *et al.* (2007) and the Elite Athlete Development Model of Cooper and Goodenough (2007) into the talent identification and development process.

3) A discussion centering on the possible inclusion of perceptual-cognitive and perceptual-motor (psychomotor) skills tests in the talent identification process.

5.2 MOTIVATION, COMMITMENT AND PRACTICE

Motivation is regarded as an important aspect of study (Scanlan *et al.,* 1993a; Murcia *et al.,* 2007b), with extensive research conducted on this concept of motivation in sport and in general (Roberts, 2001b; Cervelló *et al.,* 2007; Roberts *et al.,* 2007; Vallerand, 2007). Motivation has consistently been highlighted as being an (or the most) important factor in the attainment of success and high levels of performance in any sport (Gould *et al.,* 2002; Spamer & Winsley, 2003b; Baker & Horton, 2004; Tranckle & Cushion, 2006; Starkes, 2007; Vallerand, 2007).

As a result of this high level of focus and attention, there have been numerous theorisations and studies on motivation, and one is spoilt for choice regarding a definition of the term, with the term at times described as being ambiguous and overused (Roberts, 2001b, Roberts *et al.,* 2007). In an attempt to solve the problem presented by sheer overabundance, the common issues pertaining to a definition of motivation as highlighted by some recent studies and publications have been identified.

In quoting Cratty (1983), Schuman *et al.* (2005:146) refer to motivation as *"…the factors and processes that impel people to action or inaction in various situations."* Both Vallerand and Rousseau (2001:389) and Vallerand (2007:59) cite Vallerand and Thill (1993) when defining motivation as being *"…the hypothetical construct used to describe the internal and/or external forces that produce the initiation, direction, intensity, and persistence of behaviour."* Roberts *et al.* (2007:3) define motivational processes as *"…the psychological constructs that energize, direct, and regulate achievement behaviour."*

In rugby, Hodge and McKenzie (2002) highlight the crucial role of motivation in propelling the rugby player to excel in the season, in practice and training aspects and game related factors. They further highlight the fact that motivation is both a desire and a drive. This push-pull dualism is central to the definition of motivation for this study. While this study is not trying to reinvent the proverbial "wheel," it has as

its goal a definition that most applies to this specific context. This definition can therefore be viewed as a hybrid of the preceding definitions.

For the purposes of this study motivation can be defined as: *the internal or external processes inherent to an individual that lead to persistent, goal directed and deliberate action or actions for the purpose of achieving pre-determined outcomes or end goals.*

Two of the most researched (Mallett & Hanrahan, 2004) and prominent (Murcia *et al.,* 2007b) theories in sport psychology regarding motivation are, 1) the Achievement Goal Theory, and; 2) the Self-Determination Theory. Mallett and Hanrahan (2004) and Murcia *et al.* (2007b) attribute the Achievement Goal Theory to Nicholls (1989) and Duda (1992; 2001) and the Self-Determination Theory to Deci and Ryan (1985; 1991; 2000) and Ryan and Deci (2000), although, according to Roberts (2001b), the Achievement Goal Theory dates back the collaborative work of Maehr and Nicholls (1980), Nicholls (1980), Ames (1984) and Dweek (1986).

When the number of older and more recent studies and texts on motivation in sport is reviewed, it is clear that these two theories enjoy significant support (Duda, 1993; Chantal *et al.,* 1996; Escartí *et al.,* 1999; Brustad *et al.,* 2001; Duda & Hall, 2001; Roberts, 2001b; Vallerand & Rousseau, 2001; Weinberg & Gould, 2003; Baker & Horton, 2004; Coetzee *et al.,* 2005; Vazou *et al.,* 2006; Wilson *et al.,* 2006; Bengoechea & Strean, 2007; Cervelló *et al.,* 2007; Cumming *et al.,* 2007; Roberts *et al.,* 2007; Vallerand, 2007; Amorose & Anderson-Butcher, in press; Papaioannou *et al.,* in press).

Regarding the concept of commitment to sport, the studies of Starkes (2000), Amorose (2001), Brustad *et al.* (2001), Spamer and Winsley (2003b), Wilson *et al.* (2004), Tenenbaum and Hutchinson (2007), Weiss and Weiss (2007) and McCarthy *et al.* (in press) acknowledge the relevance of the Sport Commitment Model of Carpenter *et al.* (1993) and Scanlan *et al.* (1993a; 1993b) wherein certain

motivational considerations and their effect on sustained participation in sport are highlighted.

And then of course there is the seminal Theory of Deliberate Practice as proposed by Ericsson and colleagues (1993) regarding the importance of deliberate and sustained practice in the attainment of success and expertise in various endeavours. From the research presented in chapter four, it is clear that this Theory of Deliberate Practice has many proponents and has provided the impetus and influence for a great many studies into the nature and influence of deliberate practice and the role this plays in the development of excellence and expert performance in a number of domains, including sport. Chapter four also noted that it would be a fair assessment of the fact when saying that the Theory of Deliberate Practice has greatly influenced the study of expert performance in sport, as the representative studies that were included (Starkes, 2000, 2003, 2007; Côté *et al.,* 2003, 2007; Deakin & Cobley, 2003; Hodges *et al.,* 2004, 2006, 2007; Hyllegard & Yamamoto, 2005; Williams & Ward, 2007) and that focused on various aspects, applications and discussions of and surrounding deliberate practice, attested to.

5.2.1 Achievement Goal Theory

As underlined previously, Roberts (2001b) attributes this theory to the original work of Maehr and Nicholls (1980), Nicholls (1980), Ames (1984) and Dweek (1986). The Achievement Goal Theory assumes that *"…the individual is an intentional, goal-directed organism who operates in a rational manner, and that achievement goals govern achievement beliefs and guide subsequent decision making and behaviour in achievement contexts"* (Roberts, 2001b:10; Mallett & Hanrahan, 2004:186; Roberts *et al.,* 2007:4).

It is proposed that the overall intentions, motives and exertions of an individual are revealed through the goals this individual chooses, and that meaning can then assigned to their achievement orientated behaviour. Therefore, an individual's achievement orientated behaviour is determined by the (achievement) goals that

they embrace. But, goals can take many forms, with the Achievement Goal Theory postulating that these goals mainly centre on the individual's desire to acquire or display competence and to minimise incompetence (Roberts *et al.,* 2007).

Murcia *et al.* (2007b:172) notes that according to the Achievement Goal Theory, *"…individuals can define success according to different criteria that reflects two different perspectives."* These perspectives are reflected in the majority of the studies concerned, with the most applicable incorporated into the explanations to follow.   Also, while Roberts *et al.* (2007) is cited in the headings of these two perspectives, all the studies concerned incorporate these headings or variations thereof:

1)   Task-involved (Roberts *et al.,* 2007:5)

This is also referred to as being self-referenced. This is an achievement goal perspective where individuals consider themselves to be successful when they have shown personal progress, competence or high levels of ability in a task. These task-orientated individuals demonstrate this personal competence, progression and ability through the successful completion or "mastering" of a task and are more likely to put in effort and to persist in a task in the face of challenges or setbacks (Duda & Hall, 2001; Mallett & Hanrahan, 2004; Vazou *et al.,* 2006; Wilson *et al.,* 2006; Cervelló *et al.,* 2007; Cumming *et al.,* 2007; Murcia *et al.,* 2007b; Roberts *et al.,* 2007).

Therefore, in more practical terms, these intrinsically motivated individuals participate in tasks for "the love of it" and for the inherent challenge associated with the task. Their motivation comes from the improvement shown in their superior performance of these skills after effort has been applied. In essence, they are focused on themselves and are involved in tasks for the betterment of themselves and the associated personal advantages of these improvements.

2)   Ego-involved (Roberts *et al.,* 2007:5)

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This is also referred to as being socially comparative. This achievement goal perspective is where individuals only regard themselves as successful if they exhibit superior skills when compared to others (Duda & Hall, 2001; Mallett & Hanrahan, 2004; Vazou *et al.,* 2006; Wilson *et al.,* 2006; Cervelló *et al.,* 2007; Cumming *et al.,* 2007; Murcia *et al.,* 2007b; Roberts *et al.,* 2007).

These individuals are only happy when they beat or vanquish others in these tasks, since this provides a perspective for them that they are better than others. It can probably be assumed that they care little for personal progression as sufficient reward and only experience reward in the context of superiority over others.

A number of points originally raised by Nicholls (1984; 1989) are highlighted by Roberts *et al.* (2007) regarding task versus ego-orientated individuals. Firstly, individuals who are task-orientated attempt to illustrate a level of mastery at a task rather than merely demonstrating an average level of skill in the task. They are not merely satisfied with being able to complete a task successfully; they desire excellence. In contrast, ego-orientated individuals only seek to demonstrate an average or normative ability or skill level in a task, as opposed to excellence or even perfection, since they are only concerned with ability to be superior over others, in spite of the quality of the performance. An important driver in this regard is that these individuals are seeking to avoid showing their inability in a task.

Another characteristic highlighted by Roberts *et al.* (2007) regarding ego-orientated individuals is that when these individuals consider themselves to be highly skilled or competent in a task, they generally seek out competitive environments in which to demonstrate this superior competence or ability in relation to others. They are usually motivated to persist in the task as a way of showing this superior competence. Further, they also like to be able to demonstrate competence in comparison to others with the minimum amount of application or work, and this minimal effort further serves to demonstrate their perceived superiority over others in the task. Conversely, however, these individuals avoid competitive or challenging

environments if their perceived competence is low. Furthermore, their motivation to persist will is low and their consequent drop-out risk is high.

5.2.1.1 Profile of Goal Orientation Questionnaire (PGOQ) (Wilson *et al.,* 2006:298)

In subsequent reviews of and adaptations to the Achievement Goal Theory, Wilson *et al. (*2006:298) refer to the work of Harwood *et al. (*2002) that proposes *"…a four-goal model of achievement goals using the Profile of Goal Orientation Questionnaire (PGOQ)."*

In the model (PGOQ) of Harwood *et al.* (2002) in Wilson *et al.* (2006) the following applies:

1)   Self directed task-involvement (Wilson *et al.,* 2006:298)

This is when an individual derives a sense of achievement or accomplishment when they experience an internal acknowledgement that their skill in a task has improved. An example of this is when an individual feels more competent because they can personally notice an improvement in their performance (Wilson *et al.,* 2006).

2)   Social approval task involvement (Wilson *et al.,* 2006:298)

This entails the individual experiencing a sense of achievement or accomplishment when the recognition of their improvement in a skill or ability originates externally. An example of this is when an athlete demonstrates to their coach that they are improving in their skills (Wilson *et al.,* 2006).

3)   Self-directed ego involvement (Wilson *et al.,* 2006:298)

This is when an individual has a sense of achievement or accomplishment based upon them recognising internally that they are better than others in a task. An example of this may be when an athlete experiences a feeling of competence and satisfaction when they exhibit superiority over other participants or competitors (Wilson *et al.,* 2006).

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4) Social approval ego involvement (Wilson *et al.,* 2006:298)

This pertains to individuals feeling a sense of achievement or accomplishment when their superiority over others is recognised by an external source. An example of this is when an athlete has a sense of achievement in knowing that the coach realises that they're better than the opposition (Wilson *et al.,* 2006).

5.2.2 Self-Determination Theory

Vallerand (2007) explains that the Self Determination Theory expands upon the work of the early need theorists such as Deci and Ryan (1985; 2000). Central to this theory is the assumption that motivation is informed upon by the internal (intrinsic) needs of relatedness, self determination, autonomy and competence of the individual, and that these are essential for development and effective societal interaction (Chantal *et al.,* 1996; Deci & Ryan, 2000; Weinberg & Gould, 2003; Mallett & Hanrahan, 2004; Vallerand, 2007).

Furthermore, it is proposed that self determination and motivation can be classified along a continuum (Murcia *et al.,* 2007a, 2007b; Amorose & Anderson-Butcher, in press) consisting on the one end of individuals with no motivation (or amotivation), and on the other end of individuals who exhibit powerful intrinsic motivational characteristics.

Intrinsically motivated activities are those activities that individuals partake in for the personal satisfaction thereof or interest therein, as well as for the enjoyment and pleasure associated with the activity and the associated challenge and consequent opportunity to learn and to improve their competence (Chantal *et al.,* 1996; Vallerand & Rousseau, 2001; Mallett & Hanrahan, 2004; Amorose & Anderson-Butcher, in press).

Between the opposite poles of amotivation and intrinsic motivation lies extrinsic motivation (Amorose & Anderson-Butcher, in press). Extrinsic motivation involves the individual's participation in an activity as a means to an end, for external reward,

not for the sake of participation alone (Chantal *et al.,* 1996; Vallerand & Rousseau, 2001; Vallerand, 2007; Amorose & Anderson-Butcher, in press) or through lack of choice (Mallett & Hanrahan, 2004).

Self determined behaviour is as Deci and Ryan (2000) describe it, the process whereby individuals attempt to internalise motives that are of an extrinsic nature. Therefore, it is a process of trying, as far as possible, to transform motivation from an external character to an internal character. According to this theory there are four categories of external or extrinsic motivation, some of which are more self-determined than others (Vallerand & Rousseau, 2001; Mallett & Hanrahan, 2004; Murcia *et al.,* 2007b; Vallerand, 2007; Amorose & Anderson-Butcher, in press) and these are situated on the continuum between amotivation and intrinsic motivation.

As a result, and judging from the explanations of the preceding studies, the Self Determination Theory suggest that the whole motivational continuum ranges from, a) amotivation through to, b) self determined extrinsic motivation moving from less internally controlled to more internally controlled motivation, and finally, c) pure intrinsic motivation.

The four categories of self determined extrinsic motivation are explained in the following section and are accompanied with short examples. While Murcia *et al.* (2007b) has been cited in the category heading section, these headings are found in all the studies concerned:

1)   External regulation (Murcia *et al.,* 2007b:172)
This entails the participation in sport for external gain and persuasions with the behaviour regulated by external factors including those of constraints and benefits. This is the least self determined behaviour to be found (Deci & Ryan, 2000; Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007; Amorose & Anderson-Butcher, in press). Examples of this include the participation in sport because of the associated prestige and possible financial rewards of success, or an

individual going to practice so that the coach can see them and consider them favourably (Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007)

2) Introjected regulation (Murcia *et al.,* 2007b:172)

This infers more internalised reasons for actions, although these are still affected by external factors, even though these factors may be self-imposed. This behaviour is still less self determined than the ideal (Deci & Ryan, 2000; Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007; Amorose & Anderson-Butcher, in press). An example of this is participating in sport to assuage personal bad feelings, or attending practice because the associated guilt of missing practice would be too great to bear (Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007).

3) Identified regulation (Murcia *et al.,* 2007b:172)

This refers to action that is completely out of choice and is therefore highly self determined. Individuals participate in these activities even if these activities are unpleasant (Deci & Ryan, 2000; Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007; Amorose & Anderson-Butcher, in press). This may entail participating in sport for the express purposes of improving health or participating in weight training to improve performance, even if this weight training is not much liked or enjoyed (Vallerand & Rousseau, 2001; Murcia *et al.,* 2007b; Vallerand, 2007).

4) Integrated regulation (Murcia *et al.,* 2007b:172)

This involves doing an activity out of choice with this choice being to the benefit of other aspects of the individual (Deci & Ryan, 2000; Vallerand & Rousseau, 2001; Vallerand, 2007; Murcia *et al.,* 2007b). This can refer to participating in sport as part of one's broader attempt at a healthy and balanced lifestyle, or it may making sacrifices regarding one's social life to improve aspects of one's performance in competition (Vallerand & Rousseau, 2001; Vallerand, 2007; Murcia *et al.,* 2007b)

5.2.2.1 Hierarchical Model of Intrinsic and Extrinsic Motivation (Vallerand, 2007:60)

In an attempt to integrate the research findings on intrinsic and extrinsic motivation, the Hierarchical Model of Intrinsic and Extrinsic Motivation was first proposed by Vallerand (1997) in Vallerand (2007) and then subsequently by Vallerand (2001) and Vallerand and Rousseau (2001).

This model is best described by Vallerand (2007:60) as *"…five postulates and five corollaries. Taken together, these postulates and corollaries explain (a) the motivational determinants and consequences at three levels of generality as well as (b) the interactions among motivation at the three levels of generality, while taking into account the complexity of human motivation."*

This model has not been evaluated in-depth by this study, but it suffices to say that it extends the findings of intrinsic and extrinsic motivation by accounting for contextual, situational and personality factors as these interact with and influence each other and takes into account other considerations. The Self Determination Theory has significantly influenced this model and its development.

5.2.3   Sport Commitment Model

The Sport Commitment Model the Sport Commitment Model was developed in an attempt to understand the reasons and motivations of athletes to persist in and consistently participate in sport. (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Carpenter & Coleman, 1998; Starkes 2000; Amorose, 2001; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Tenenbaum & Hutchinson, 2007; Weiss & Weiss, 2007). The original authors (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b) intended this model to be applied to both adult and youth sport at a recreational and elite level.

There are some (Brustad *et al.,* 2001; Tenenbaum & Hutchinson, 2007) who point to the preceding work of Scanlan and Simons (1992) as contributing to the development of this model. And, this model has even been referred to by Spamer

and Winsley (2003b) in their study on talent identification with eighteen year old English and South African rugby players. .

Scanlan *et al.* (1993a:3) highlight three important factors pertaining to commitment. These include the definition of commitment, which they define as, a *"…general psychological state."* Furthermore, they stress the fact that their model needs to be distinguished from the "causal" as well as the consequences of commitment, and note that they are specifically concerned with the *"…state of commitment and its antecedents or determinants."* They do go on to say that their model does consider the *"…behavioural consequences"* of commitment. And finally, Scanlan and colleagues (1993a:4) view commitment as reflecting *"…either wanting to or having to continue, or some combination of the two."*

According to this model, commitment to sport is a function of several independent factors or constructs that either have an augmenting influence on sport commitment and participation, as their respective ratings increase. These are named and described in short hereafter. Scanlan *et al.* (1993a) has been cited as the source of the headings, but, these headings appear in all the studies concerned:

1)   Sport enjoyment (Scanlan *et al.,* 1993a:6)

This refers to how much the child enjoys participating in the sport and refers to the amount of pleasure, liking and fun the child derives from their involvement (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

2)   Involvement alternatives (Scanlan *et al.,* 1993a:7)

This entails the attractiveness of other alternatives or involvement opportunities that would compete with the child's current involvement and could likely influence their persistence in their current endeavour (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

3)   Personal investment (Scanlan *et al.,* 1993a:7)

This is defined as the investment of personal resources such as effort, money and time into the activity. The nature of this investment is that it is irretrievable if the child ceases participation in this activity (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

4)   Social constraints (Scanlan *et al.,* 1993a:7)

This refers the expectations of others that weigh on the child's decision to participate and persist in an activity (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

5)   Involvement opportunities (Scanlan *et al.,* 1993a:8)

This has to do with highly regarded opportunities that may present themselves should the child persist in the activity and include the "perfection" of the task or social interaction or even the achievement of higher honours in the sport or task (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

The respective augmenting and diminishing influence of each of these constructs can be identified. The influence of increased or augmented enjoyment, personal investment, social constraints and involvement opportunities has a positive impact on commitment to a sport or activity. Conversely, the influence of increased involvement opportunities has the potential to diminish or decrease commitment to a sport or an activity (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Brustad *et al.,* 2001; Wilson *et al.,* 2004; Weiss & Weiss, 2007).

Scanlan and colleagues (1993a) implied that children are usually involved in multiple activities and that this negated the potentially negative impact of increased involvement opportunities. Furthermore, they found the two most important of these constructs were personal investment and sport enjoyment with these accounting for 58% of the variance in sport commitment.

An important note at this juncture is that the original authors of this model (Scanlan *et al.,* 1993a:2) stated that they expected the model to *"…undergo change. With further testing, we will better understand which model components work in diverse sport contexts, and what modifications and additions to the model and its measures are required"* and this has in fact happened.

In citing the findings of the investigations of Carpenter and Coleman (1998) and Carpenter and Scanlan (1998) on the Sport Commitment Model, Wilson *et al. (*2004) highlights that social constraints were found to be unassociated or even to have negative correlations with commitment. Furthermore, the findings of Carpenter and Coleman (1998) in their study of elite cricketers were that social support as a construct has a positive association with sport commitment, with the opposite also true.

5.2.4   Deliberate Practice

The Deliberate Practice Theory of Ericsson *et al. (*1993) was included in the preceding chapter (four) of this study due to its highly nurturist viewpoint and due to the subsequent proposals of its first author and main proponent in this study and others (Ericsson & Lehmann, 1996; Ericsson, 2003a, 2003b, 2007a, 2007b; Ericsson *et al.,* 2005, 2007a, 2007b) that all limitations can be overcome by proper, deliberate and focussed practice. These arguments also reject the genetic contribution to excellence in sport. Their argument therefore stands (and is extended) that excellence and expertise is achieved almost solely as a result of this deliberate and focused practice.

It is not within the scope of this section to evaluate this theory's main tenets (for an in-depth review, see chapter four) but, the focus will rather rest on one of the original proposals that high levels of motivation and commitment (psychological constructs) are needed to persist in this process of deliberate practice are also considered, as well as the fact that in contrast to the Sport Commitment Model, it is postulated that deliberate practice is not enjoyable.

The Theory of Deliberate Practice of Ericsson *et al.* (1993) has as its central thesis that those who exhibit expertise or excellence in a domain consistently engage in deliberate and specific practice activities and efforts that are well defined and structured, with this practice serving the purpose of improving specific important aspects of performance through continuous repetition and subsequent improvement (Ericsson *et al.,* 1993; Ericsson & Lehmann, 1996; Durand-Bush & Salmela, 2001; Johnson *et al.,* 2006; Ericsson, 2004, 2007a).   In so doing, these individuals continually and consistently improve those aspects that are critical to excellence and superior performance in the task.

Important constraints inherent to this theory were identified by Ericsson *et al. (*1993) and two of the most pertinent are earmarked for this evaluation:

One of the original constraints was that a high degree of effort is required, since deliberate practice entails significant physical and mental demands (Ericsson *et al.,* 1993; Starkes *et al.,* 2001; Durand-Bush & Salmela, 2001; Baker *et al.,* 2003a, 2003b, 2005; Janelle & Hillman, 2003; Summers, 2004; Ward *et al.,* 2004; Hyllegard & Yamamoto, 2005; Côté *et al.,* 2007; MacMahon *et al.,* 2007).

Another constraint is that deliberate practice is not an enjoyable activity and therefore requires strong motivation to persist in this process. (Ericsson *et al.,* 1993; Starkes *et al.,* 2001; Durand-Bush & Salmela, 2001; Baker *et al.,* 2003a, 2003b, 2005; Janelle & Hillman, 2003; Summers, 2004; Ward *et al.,* 2004; Baker *et al.,* 2005; Hyllegard & Yamamoto, 2005; Côté *et al.,* 2007; MacMahon *et al.,* 2007).

As the original authors (Ericsson *et al.,* 1993) rightly state, sufficient mental (and physical) resources would certainly be required to persist in the kind of training and practice that they propose. As is shown later in this chapter, the proper type of motivation (it is proposed by this study that this requisite motivation is characterised by a task orientated goal perspective rather than the converse ego orientation; it also

needs to be heavily biased in favour of an intrinsic motivational approach) is critical to persist in this kind of training.

And, since Ward *et al.* (2004:232), when referring to the original work of Ericsson *et al.* (1993), observe that the *"…motivation to sustain participation is largely determined by one's intent to improve. Without the goal of improving performance, the motivation to engage in such practice is likely to diminish,"* the task centered, intrinsic motivation sentiments forwarded in the previous paragraph make perfect sense.

Persistent, specific and deliberate practice that is advantageous to the development and constant improvement of all the physical and skill related aspects that are required for superior performance in sport is of the utmost importance (Baker & Davids, 2007b).   To persist in this kind of practice requires total commitment, dedication and motivation.

5.3   PERCEPTUAL-COGNITIVE AND PERCEPTUAL-MOTOR SKILLS

5.3.1   Perceptual-cognitive abilities and skills

From a brief cross-sectional representation of the literature, the views are unanimous that cognitive and related perceptual abilities are overwhelmingly influential in motor performance and the associated attainment and achievement of excellence and expert performance in elite sport (Williams *et al.,* 1994; Tenenbaum *et al.,* 1996; Helsen & Starkes, 1999; Tenenbaum *et al.,* 1999; Singer, 2000; Williams, 2000, 2002; Starkes *et al.,* 2001; Baker *et al.,* 2003a, 2003b; Ericsson, 2003a; Ward & Williams, 2003; Williams & Ward, 2003; Williams *et al.,* 2003, 2004; Elferink-Gemser *et al.,* 2004; Williams & Ericsson, 2005; Hodges *et al.,* 2006; Vaeyens *et al.,* 2007; Williams & Ward, 2007; Pesce *et al.,* in press).

5.3.1.1 Background

Research into expertise and expert performance has a history spanning more than 100 years in psychology (Ackerman & Beier, 2003), with a number of the more recent research paradigms and approaches regarding the study of perceptual-cognitive expertise and abilities increasing in popularity from the 1970's and onwards (Hodges *et al.,* 2006).

It is however the important work of de Groot (1978), originally performed on chess masters and lesser players and first completed in 1946, that is considered the mainspring of all expertise study (Ericsson, 1996a; Williams & Ericsson, 2005; Ericsson, 2006a). Ericsson (2006a) feels that it was upon the translation of de Groot's (1946) study into English at the end of the 1960's that the full impact of his work was felt, with this providing impetus to the work of Simon and Chase (1973) and their so-called "seminal theory of expertise."

It was noted earlier that while sport psychology is certainly not a new science (Weinberg & Gould, 2003), it has experienced a relatively recent rise in prominence, with the start of this rise dating back to the 1960's and 1970's (Singer *et al.,* 2001; Weinberg & Gould, 2003; Wuest & Bucher, 2006).

Central to the cognitive and perceptual-cognitive perspectives is the information processing theory and the associated theorisations around this theory, as well as its application to excellence and expertise in sport from a psychological perspective. Therefore, before the information processing theory is reviewed, a brief discussion regarding its evolution and development is in order. The main thrust and drive in the development of the information processing approach is what is commonly termed the "cognitive revolution", discussed hereafter.

5.3.1.1.1 *Cognitive Revolution*

Concurrent with and contributing to the development and evolution of sport psychology as a self standing discipline in the second half of the previous century, there arose a psychological school of thought based on a cognitive perspective.

This came about as a result of changes in the approach to psychology at the time, with these changes at various times being referred to as *"The cognitive trend"* (Jordaan & Jordaan, 1984:31), *"…'cognitive revolution'"* (Summers, 2004:6), *"The rise of cognitivism"* (Amirault & Branson, 2006:78) and others. The term chosen for this study is the cognitive revolution.

The origin of cognitive psychology can be traced back to this cognitive revolution, starting in the 1960's in response to the perceived limitations of behaviourism (Jordaan & Jordaan, 1984, 1998; Summers, 2004; Anderson, 2005; Amirault & Branson, 2006) and gave rise to the information-processing approach. The information-processing approach has impacted upon research into psychology since its inception (Singer, 2000; Summers, 2004; Feltovich *et al.,* 2006) and is discussed in more detail later in this chapter.

Three main sources are commonly identified by researchers (to varying degrees) as contributing toward the cognitive revolution and the resultant development of the information-processing approach:

1) The decline of the influence of behaviourism.
2) The impact of linguistics.
3) The rise of artificial intelligence.

These will be briefly reviewed hereafter:

1)   Behaviourism is an approach to psychology that adopts the view that only observable behaviour in humans can be studied, since thought processes and consciousness cannot be measured in an objective manner. The father of this approach is John B. Watson and the first decade of the 1900's is regarded as the period in which this approach has its origin (Jordaan & Jordaan, 1984, 1998; Reber, 1985; Anderson, 2005; Feltovich *et al.,* 2006).

This approach was felt to be too limiting and unable to explain certain psychological aspects (Cummins & Cummins, 2000). Due to the impractical nature of this to adequately explain general mental capacities and advanced mental faculties such as creativity in language and the ability to reason in a logical manner, it lost its hold on psychology (Jordaan & Jordaan, 1984, 1998; Summers, 2004; Anderson, 2005).

2) Linguistics is *"…the study of the origins, evolution and structure of language(s)"* (Reber, 1985: 405). Linguistics was found to adequately address some of the afore-mentioned complex human processes and in so doing helped to counteract the influence of behaviourism (Anderson, 2005; Feltovich *et al.,* 2006). The influential contributions of Noam Chomsky in the late 1950's and 1960's are regarded highly in the field of linguistics (Reber, 1985; Anderson, 2005; Feltovich *et al.,* 2006).

3) Steedman (1998:173) defines the relationship between cognitive science and artificial intelligence as follows: *"Cognitive science is a field that builds on knowledge from many disciplines. Important contributions have come from computer science, especially from artificial intelligence."* Buchanan *et al. (*2006) refer to one prominent branch of artificial intelligence as seeking to understand and "faithfully simulate" the approaches and methods of humans in solving problems, and they call this the psychological branch of artificial intelligence.

Historically, the field of artificial intelligence started midway through the 1950's (Buchanan *et al.,* 2006). Since then it has developed and become focused on more complicated tasks and environments characterised as being rich in knowledge. As a result of this increased focus on what is termed strong, "knowledge based" methods of research, a totally new expert systems industry was born (Feltovich *et al.,* 2006). It is said that the principles of artificial intelligence form the backbone of these expert systems, with Buchanan *et al. (*2006:87) describing expert systems as *"…computer programs that exhibit some of the characteristics of expertise in human problem solving, most notably high levels of performance."*

5.3.1.1.2   Information-processing approach

As established earlier, the result of the cognitive revolution was the information-processing theory/approach. The information-processing approach/model provides an explanation for the performance of humans in motor tasks.

The information participants receive from their immediate environment proceeds through various stages to arrive at a decision and an associated outcome. The general stages commonly identified by most studies are, 1) identifying a stimulus through perception; 2) deciding on or selecting an appropriate response, and; 3) executing the appropriate response (Allard, 1993; Wrisberg, 1993, 2001; Coker, 2004; Summers, 2004; Anderson, 2005; Hodges *et al.,* 2006; Wuest & Bucher, 2006). Coker (2004) and Wuest and Bucher (2006) add another stage to this process, namely that of feedback of outcomes and results, with this feedback assisting the individual in modifying their performance.

Often the explanation for this cognitive behaviour uses the computer (Singer, 2000; Summers, 2004). An important aspect of this approach is the total time taken to react or to respond (called reaction-time) to the stimulus, with this providing an idea of the processing speed and ability of the individual (Wrisberg, 1993, 2001; Hodges *et al.,* 2006). It is the information processing approach of cognitive psychology that has been the major thrust of psychological research into excellence and expert performance in general (Summers, 2004) and in sport (Hodges *et al.,* 2006) since its inception.

Decision making and anticipation are regarded as prominent perceptual-cognitive abilities or skills, with decision making also referred to as response selection. The number of studies (Tenenbaum *et al.,* 1996; McMorris, 1999; Lyoka & Bressan, 2003; Zoudji & Thon, 2003; Bock-Jonathan *et al.,* 2007; Vaeyens *et al.,* 2007) and texts (Tenenbaum, 2003; Hodges *et al.,* 2006, 2007; Williams & Ward, 2007) focusing on or stressing the importance of decision making, anticipation and the

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different aspects associated with these abilities, serve to confirm the importance of this ability in sport.

An important part of effective decision making is perception and vision. Skill in perception is imperative to superior ability in sport (Williams, 2000, 2002; Starkes *et al.,* 2001; Ward & Williams, 2003; Vaeyens *et al.,* 2007; Pesce *et al.,* in press). And, while visual system itself is regarded as being critical to aiding skilled perception (Ward & Williams 2007) and the search for relevant information needed to perform at optimal levels (Williams, 2002), there is little concrete proof that those who excel at sport do so because of an advantage in their visual systems or abilities as such (Ward & Williams, 2003; Vaeyens *et al.,* 2007; Williams & Ward, 2007).

This distinction between the visual system and associated perception is significant. Williams (2000), Starkes *et al. (*2001) (and others) distinguish between those components of vision that are fixed and cannot be changed (traditionally called "hardware") such as depth perception and peripheral vision and those components that can be changed, learned and practiced (traditionally called "software") such as recall and recognition, visual search strategies, game information, sport specific knowledge and even eye movement responses.

There is little evidence that skilled sports participants have enhanced or superior visual systems (Baker, 2003; Ward & Williams, 2003; Baker & Horton, 2004; Williams & Ward, 2007). Cooper and Goodenough (2007) do however refer to the work of Dr. Sherylle Calder in successfully developing and improving not only visual reaction time and memory, but also variable depth and peripheral vision, amongst others. Meir (2005) in turn ascribes to visual fitness in sports. In citing Calder (1995) and Wilson and Falkel (2004), Meir (2005) goes on to say that by training the visual fitness of players, aspects such as peripheral vision, visual-perceptive skills, focusing skills and eye-movement skills can be enhanced. There are also further suggestions that studies be done examining how visual function improves with age and maturation (Williams & Ward, 2007).

Of particular interest to researchers is that of what is perceived by the individuals from the sporting environment and how this perceived information is detected and optimally utilised. It has been said earlier in this chapter, but, experts are superior in many of the perceptual-cognitive aspects of performance (Starkes *et al.* 2001; Williams *et al.,* 2004; Hodges *et al.,* 2007; Williams & Ward, 2007) and it is these aspects that are of interest to the following sub-section of this study.

5.3.1.2 Leading research findings

In this sub-section, the leading and enduring research findings regarding the perceptual-cognitive advantages that expert athletes possess in greater abundance than non-expert athletes are presented. These findings have been confirmed in research time and again and consequently, scores of research and associated findings exist on most of the issues. While the headings of each point in this sub-section will be attributed to a specific study, this by no means implies that it is merely that specific study that has raised these findings, as the accompanying references to each point attest to.

With this in mind, the following prominent findings apply:

5.3.1.2.1   Information recall, retention and recognition (Helsen & Starkes, 1999)
Superior performers have better information or pattern recall, retention and recognition abilities in environments that are structured or conform to a known pattern, than do less successful performers (Williams *et al.,* 1994, 2003, 2004; Helsen & Starkes, 1999; Tenenbaum *et al.,* 1999; Williams, 2000; Starkes *et al.,* 2001; Baker *et al.,* 2003b; Lyoka & Bressan, 2003; Ward & Williams, 2003; Williams & Ward, 2003, 2007; Abernethy *et al.,* 2005; Hodges *et al.,* 2006; Vaeyens *et al.,* 2007). This translates into a distinct advantage on the field when making decisions and selecting responses to the unfolding game environment (Lyoka & Bressan, 2003; Hodges *et al.,* 2006).

The essential premise of this advantage in recall, retention and recognition of information that experts possess over others is their ability to organise the information they perceive in their specific environment into larger units for storage in memory and for subsequent recall and utilisation in game scenarios (Williams, 2000; Lyoka & Bressan, 2003). It can be assumed from these explanations that as an individual gains experience in a domain (this can include sport) through active involvement by means of practice and competition, they become more effective with this memory recall, retention and recognition.

It is the original research of Chase and Simon (1973a; 1973b) and de Groot (1978), all on chess that first gave impetus to these findings. The process of organising and storing information mentioned in the paragraph above is called "chunking," and it was Chase and Simon (1973a; 1973b) who proposed this theory (Williams, 2000; Baker, 2001; Lyoka & Bressan, 2003; Tenenbaum, 2003; Ericsson, 2006a; Gobet, 2005; Williams & Ericsson, 2005; Feltovich *et al.,* 2006; Hodges *et al.,* 2007). There are others (Baker, 2003; Baker *et al.,* 2003c; Ericsson, 2003a, 2004, 2005, 2006a; Feltovich *et al.,* 2006; Williams & Ward, 2007) who also attribute the theory of chunking or certain aspects thereof to the specific study of Simon and Chase (1973) as well.

But, the significance of de Groot's (1978) work can also be appreciated. Originally, de Groot's (1978) ground breaking study was completed in 1946 and was done on the differences in performance between the world's top chess players as compared to less skilled club players, with his study is widely acknowledged by many as being of great value to the field of expertise. Others (that are also included in these references) go further in stating that de Groot's (1978) study can be seen as being contributory to the development of the first expertise theory (Ericsson & Lehmann, 1996; Ericsson, 2003a, 2004, 2005, 2006a, 2007a; Williams & Ericsson, 2005; Gobet & Charness, 2006).

The specific findings of de Groot's (1978) research were that the superior performers could be distinguished with regards to their memory, in that they could recall briefly presented chess positions far better than the lesser skilled performers (Gobet & Charness, 2006). Further findings were that their advantage lay in their reliance on planning and patterns that they acquired over time (Ericsson, 2006a) and that they had a superior ability to select the next best move (Ericsson, 2005, 2007a; Vaeyens *et al.*, 2007). De Groot's (1978) study is highly regarded and is seen as having great impact upon the studies of expertise studies that followed, the most significant of which being the study of Simon and Chase in 1973 (Ericsson, 2006a).

The prominence of Simon and Chase (1973) lies in the fact that they elaborated on de Groot's (1978) original work by proposing the first major expertise theory (Ericsson, 2003a, 2005, 2006a; Williams & Ericsson, 2005). The specific and enduring contributions of Simon and Chase (1973) are the fact that they observed that nobody attained the level of international chess master (grandmaster) with less than a decade's worth of intense preparation, with this finding also applicable to other domains (Ericsson & Lehmann, 1996; Baker *et al.*, 2003a, 2003b, 2003c; Baker & Horton, 2004; Ericsson, 2004, Ward *et al.*, 2004; Charness *et al.*, 2005). And, as noted earlier, the chunking theory (or aspects thereof) is also attributed to their study by researchers (Baker, 2003; Baker *et al.*, 2003c; Ericsson, 2003a, 2004, 2005, 2006a; Feltovich *et al.*, 2006; Williams & Ward, 2007).

As a summary of this concept, in applying chunking to a sporting context, it can be said that chunking is the organisation of information into patterns and configurations of memory. It is in the decoding and encoding processes whereby the relevant information configurations are recognised and either retrieved or stored (Allard, 1982 in Lyoka & Bressan, 2003). This more highly developed ability to encode, decode and chunk the applicable aspects of the game results in the improved ability of top performers to display more efficient decision making skills. Experts and superior performers have been shown to be superior in the perception of the information emanating from the game environment, to be faster with memory processing

abilities, to be able to efficiently access and recall the applicable information structures, with this enabling them to be more effective decision makers (Garland & Barry, 1990 in Lyoka & Bressan, 2003).

The theories Simon and Chase (1973) and Chase and Simon (1973a; 1973b) have been questioned, and in certain cases disproved (Ericsson, 2003a; Ericsson, 2005; Williams & Ericsson 2005). This doesn't detract from the legacy that they and de Groot (1978) left in the field of psychological enquiry into expertise and expert performance (with this also extending to sport) however. The preceding discussion is more than enough evidence of the fact that they are still held in high regard.

5.3.1.2.2   *Sport-specific knowledge (Bock-Jonathan et al., 2007)*

Superior performers possess greater amounts of task (Williams & Davids, 1998) and domain-specific knowledge, and this is true of sport as well (Helsen & Starkes, 1999; Bock-Jonathan *et al.,* 2007). Domain and sport-specific knowledge is contained in the amount of procedural, declarative and strategic knowledge the participant possesses (French & McPherson, 1999; Helsen & Starkes, 1999; Kluka, 1999; Starkes *et al.,* 2001; Thomas *et al.,* 2001; Janelle & Hillman, 2003; Hodges *et al.,* 2006). Declarative knowledge implies an overall knowing and understanding of the sport, such as the rules, positions and others (Kluka, 1999; Thomas *et al.,* 2001; Janelle & Hillman, 2003; Lyoka & Bressan, 2003; Elferink-Gemser *et al.,* 2004; Hodges & Franks, 2004; Hodges *et al.,* 2007). Procedural knowledge entails understanding how to play the sport (Kluka, 1999; Thomas *et al.,* 2001; Janelle & Hillman, 2003; Lyoka & Bressan, 2003; Elferink-Gemser *et al.,* 2004; Hodges *et al.,* 2006, 2007). Finally, strategic knowledge is knowledge of how to most effectively or proficiently perform the task or to play the game under the prevailing circumstances (Kluka, 1999; Janelle & Hillman, 2003).

Lyoka and Bressan (2003), in citing Papanikolau (2000), refer to the term athletic intelligence as relating to the types of knowledge needed to be successful in sport. In expanding on this concept, a review of Gould's *et al. (*2002) findings on this topic

is quite relevant. The authors commented that this aspect of sport intelligence (along with mental toughness-see later in this chapter) was to them a new variable that was identified is being quite valuable. Under this concept were listed aspects such as having a firm grasp of the elite nature of sport, good decision making, being analytical, innovative and able to learn quickly and being a student of the sport.

When compared to Lyoka and Bressan's (2003) views that sport intelligence entails being able to effectively perform the proper and most relevant skills in a specific context, then this concept of sport intelligence as an extension of domain and sport-specific knowledge becomes a fruitful and ripe topic for future enquiry. Further investigation into this aspect is also a recommendation of Gould and colleagues (2002).

5.3.1.2.3 *Faster and more efficient processing of information (Starkes et al., 2001*

Superior performers deal with and process the information they receive from the environment more quickly and effectively than others (Helsen & Starkes, 1999; Starkes *et al.,* 2001; Williams *et al.,* 2004; Bock-Jonathan *et al.,* 2007). This ability is a critical determinant of decision making and anticipation and is related to factors such as pattern recognition (discussed before), effective utilisation of advanced cues, the ability to determine situational probabilities and effective visual search behaviours (Williams & Ward, 2007). Each of these factors will be briefly discussed hereafter:

5.3.1.2.3a *Situational probabilities (Williams et al., 2004:332)*

The concept of situational probabilities refers to when superior performers have the ability to establish or predict where a current situation will lead or end up (Baker, 2001; Starkes *et al.,* 2001; Williams & Ward, 2003, 2007; Williams *et al.,* 2004; Vaeyens *et al.,* 2007).

5.3.1.2.3b *Visual search behaviour (Williams et al., 2004:330)*

Superior performers have more effective visual search behaviours and strategies in relation to others (Williams & Davids, 1998; Helsen & Starkes, 1999; Starkes *et al.,* 2001; Williams, 2002; Ward & Williams, 2003; Williams & Ward, 2003, 2007; Williams *et al.,* 2004; Hodges *et al.,* 2006, 2007; Vaeyens *et al.,* 2007). There have been interesting findings in this field, particularly with regards to the fixations that players employ in sport and the differences between experts and non-experts. It has been found that experts generally employ less eye fixations than non-experts, but that this is also highly specific to the sport involved, where studies have also shown more eye fixations and altered search strategies in experts in different situations (Hodges *et al.,* 2006, 2007). Furthermore, Vaeyens *et al.* (2007) found that different circumstances also called for different visual search strategies involving the rate of search, the number of eye fixations and the length of these eye fixations.

5.3.1.2.3c   *Advanced cue utilisation (Williams & Ward, 2007:205)*

It has been shown by extensive studies that superior performers have an advantage in their ability to make use of advanced cues (Abernethy & Russell, 1987; Williams *et al.,* 1994, 2003, 2004; Helsen & Starkes, 1999; Starkes *et al.,* 2001; Lyoka & Bressan, 2003; Ward & Williams, 2003; Williams & Ward, 2003, 2007; Abernethy *et al.,* 2005; Hodges *et al.,* 2006; Vaeyens *et al.,* 2007).

This utilisation of advanced cues is when superior performers can anticipate and predict immediate or imminent future events based on the information emanating from opponents. This advanced cue utilisation occurs when information is derived from body or postural cues presented by opponents in the way they move and even before they make contact with a racquet, volleyball or a football. In this way experts often accurately interpret the direction of the opponent, ball or object and can make the adjustments needed to successfully attend to the required task or response (Abernethy & Russell, 1987; Starkes *et al.,* 2001; Williams *et al.,* 2004; Hodges *et al.,* 2006; Williams & Ward, 2007).

5.3.1.2.4   *Trainability and transferability of perceptual-cognitive abilities*

As a final consideration of this sub-section, the prospects of training and transferring these perceptual and cognitive abilities and skills is discussed, with these issues raised by a number of authors and studies (Starkes *et al.,* 2001; Williams & Ward, 2003; Williams *et al.,* 2003, 2004; Hodges *et al.,* 2006; Vaeyens *et al.,* 2007; Williams & Ward, 2007). It seems that while the proverbial "jury" is still out on the issues of both the trainability and transferability of (certain) perceptual-cognitive abilities, there are some findings to date worth mentioning.

1)   The development of the expert advantage in information recall, retention, recognition due to extended practice and exposure to (training in) a sport, as well as the associated and implied requirements for training and exposure when developing task and sport-specific knowledge, has been well documented earlier in this chapter. In fact, without *dedicated practice*, there will be *no development* of *or improvement* in these skills. In going further, Williams and Ward (2007) are of the opinion that the results obtained from studies aimed at training other perceptual-cognitive aspects and skills using simulation and instruction can be said to be encouraging. They and Williams *et al.* (2004) do however cast a light on the methodological shortcomings and the lack of literature that sustain these findings.

According to Williams and Ward (2003), Williams *et al. (*2004) and Jordet (2005), the majority of research into the trainability of anticipation skills has focused on and attempted to train the individual to improve their ability in utilising advanced cues to improve their performance. But, in spite of the research limitations encountered in many studies of this type, in other well designed studies some impressive results were obtained. In the work of Williams *et al.* (2003) aimed at improving the anticipation skills of field hockey players through developing their ability to read advanced cues, a (perceptual) training effect was found (Williams & Ward, 2003; Williams *et al.,* 2003, 2004). The issue of pattern recognition has received little attention, with situational probabilities receiving none to date (Williams & Ward, 2003; Williams *et al.,* 2004).   In a study by Vaeyens *et al.* (2007), a suggestion was

made for the task-specificity in practice when attempting to improve visual search strategies, indicating another possible avenue of perceptual-cognitive training.

2)	The question of the transferability of perceptual-cognitive expertise and ability is truly an intriguing one. Ericsson and Lehmann (1996) and Feltovich *et al.* (2006) are of the opinion that expertise is not a general ability that can be transferred to many domains and that you don't find people who are experts in more than one field or domain. Furthermore, task specificity relating to expertise in surgery is mentioned by Norman *et al. (*2006), who say that the ability inherent to one surgical task does not transfer to another surgical task. Lehmann and Gruber (2006) for their part say that in music, the improvement that comes about in musicians as a result of practice is limited to the specific instrument they are practicing on. It seems that is quite simply very rare or nigh on the impossible to be an expert in the strictest sense of the word, in more than one domain.

Or is it? MacMahon *et al. (*2007:65) phrase their sentiment nicely and succinctly by asking *"How domain-specific are domain-specific skills?"*

It is common knowledge that skill transference occurs in motor skill acquisition and development (Magill, 1998; Wuest & Bucher, 2006). Furthermore, du Toit *et al.* (2006a:47) found that *"…a transfer effect of eye-hand co-ordination skills from the right to the left cerebral hemispheres does exist"* after practicing unilaterally to develop the co-ordination skills of the left hand. Grassi *et al.* (2006) also found skill transfer in hand-eye coordination. But, while these examples certainly support motor-skill transfer under certain basic and limited conditions, is there a specific, perceptual-cognitive transfer to be found at high levels of sport participation?

Evidence for this transfer is beginning to emerge. Hodges *et al.* (2006:478) say that some of the information and findings from certain studies *"…suggests that some transfer of perceptual skill is seen across sports with similar skill demands."*

Others, such as MacMahon *et al.* (2007) make mention of yet other studies, such as those of Smeeton *et al.* (2004) and Abernethy *et al.* (2005) that investigated the transferability of perceptual-cognitive skill. Upon closer analysis of these specific studies, the following can be seen: Abernethy *et al. (*2005) found that the elite performers of various sports did show limited amount of transfer of pattern recall from sports that were not their own, with the study of Smeeton *et al. (*2004) generating similar results. In the study of Smeeton *et al. (*2004), the highly skilled field hockey and soccer players were found to be able to identify action sequences from both sports. The highly skilled volleyball players were found to be the worst at recognising action sequences of both soccer and hockey, with no differences found between recognition ability of the soccer, volleyball and hockey players when required to recall volleyball action sequences. The findings of these studies therefore show that there is transfer of perceptual-cognitive skills between similar sports types, a view that Abbott *et al.* (2007) also hold to.

MacMahon *et al.* (2007), however mention that while there may be transfer between perceptual-cognitive skills that are similar in nature, there is no transfer of perceptual-cognitive skills between *differing roles.* MacMahon *et al.* (2007) strengthen their argument by citing the studies of Allard *et al. (*1993) and Williams and Davids (1995) that provide examples of role specific perceptual-cognitive expertise and ability.

Since the evidence provided seems arrive upon a stalemate, a search of real life cases suffices. A number of examples were found. Fein (2007) noted that Scott Draper, a former professional tennis player, had successfully made the transition to professional golf by winning the New South Wales PGA Championship in February of 2007. Former All Back rugby player Jeff Wilson also successfully transitioned from rugby to become a Black Cap national cricket player (Unknown Author, 2007b). Closer to home Conrad Jantjes achieved junior South African colours in rugby as well as soccer and cricket (Unknown Author, 2005). South African cricket player and opening batsman Herschelle Gibbs played soccer for the South African Schools

Under-16 team (Unknown Author, 2007c). And, former South African cricket player Jonty Rhodes also represented South Africa at hockey and was picked to go to the Barcelona Olympic Games in 1992; unfortunately the squad did not qualify for the tournament (Unknown Author, 2007d). Abbott *et al.* (2007) also provide evidence of sportspersons who transfer from one sport to another, and they are of the opinion that this ability to transfer from one sport to the next is as a result of early diversification in sport and a focus on many sports as opposed to an early one sport focus.

Therefore, while it is almost a given that perceptual, cognitive and motor skill transfer assisted in these transitions between and excellence in multiple sports endeavours, it has been noted throughout this study that performance does not just consist of these aspects, but of certain physical and physiological parameters too. Therefore, a solution would perhaps be to study the specific perceptual-cognitive skills as well as other physiological aspects and abilities of such individuals who are successful in multiple sports.

5.3.2   Perceptual-motor abilities and skills

The literature also highlights the recent rise of alternative approaches to researching expertise and expert performance. The specific perspectives and views within literature and as contained in some of this literature cited in preceding sections, as well as other literature, have been included in this section.

Just as the cognitive school of thought arose out of the perceived limitations of behaviourism in explaining complex behaviours, so too another change in perspective is occurring due to the perceived short-comings of the cognitive approach in explaining skilled behaviour and excellence (Summers, 2004). These alternative theories and explanations to the traditionally cognitive explanations of expert performance that have arisen of late are those of the ecological and dynamical systems theories (Davids *et al.,* 2001, 2007; Starkes, 2003; Summers, 2004; Hodges *et al.,* 2006; Williams & Ward, 2007), with both Kluka (1999) and

Summers (2004) of the opinion that the dynamical systems approach arose from ecological psychology.

While these two theories and approaches have some differences, they do have certain similarities. The most prominent similarity between these approaches is that they both largely refute the traditional view that is reliant on cognition and cognitive factors to facilitate skilled movement and excellence (Kluka, 1999; Beek *et al.,* 2003; Coker, 2004; Summers, 2004; Rosenbaum *et al.,* 2006; Williams & Ward, 2007). Cognitive factors are relegated by these approaches to the role of *"…setting up self-assembly (i.e. leading to the emergence of self-organized behaviour), not explicitly controlling such processes during movement coordination"* (Davids *et al.,* 2001:144; Araújo *et al.,* 2004:418).

Another similarity that has been identified by Beek *et al.* (2003) is that both these approaches emphasise factors that are reliant on or determined by a number of elements and that these factors and elements in turn influence perception and action. To further illustrate this, Davids *et al. (*2007:227), in referring to Bernstein (1967), explain that *"Researchers in these areas have typically adopted a systems perspective. They have sought to characterize biological movement systems as complex, dynamical systems, revealing how the abundance of degrees of freedom is coordinated and controlled during goal-directed movements."* Therefore, according to Davids *et al.* (2007), these approaches are relevant to sport psychology because, being described as "constraints-based frameworks," they explain the behaviour of "biological organisms" as being the result of the relationship and interactions between these organisms and their specific environments.

While both approaches are concerned with the concept of degrees of freedom (Davids *et al.,* 2007), these degrees of freedom are applied within specific contexts. And, it is in this contextual application that their subtle differences reside.

Beek *et al.* (2003) and Williams and Ward (2007) offer a helpful distinction between these two approaches; while ecological psychology is mostly concerned with educating attention and gaining control over the degrees of perceptual freedom that are required to effectively perform a motor task, dynamic systems theory is concerned with controlling the various degrees of freedom (other than, but not excluding perception) that are important to the superior performance of this task. To further analyse these approaches, a short synopsis of each approach is provided hereafter:

5.3.2.1 Ecological psychology

From the ecological perspective, the process of "educating attention" is seen as an integral part to learning and the subsequent skilled performance (Beek *et al.,* 2003; Hodges *et al.,* 2006; Williams & Ward, 2007). In this process, specific sources of information needed for the correct execution of the task (also known as specifying higher order invariants/sources of information) are identified (while reducing nonspecifying information) and utilised to effectively perform the task (Beek *et al.,* 2003; Savelsbergh *et al.,* 2004; Williams & Ward, 2007). Closely associated to the concept of educating attention is the process of mastering the perceptual degrees of freedom. In fact, Savelsbergh *et al.* (2004) show that mastering these perceptual degrees of freedom is required to educate attention.

Therefore, mastering perceptual degrees of freedom can be described as the "freezing" followed by a later, gradual "freeing" and an eventual, subsequent "exploitation" of perceptual degrees of freedom (Savelsbergh *et al.,* 2004; Williams & Ward, 2007). Interestingly, while both Huys *et al.* (2004) and Savelsbergh *et al.* (2004) make note of this freezing, freeing and exploiting degrees of freedom in motor control and coordination, Savelsbergh *et al.* (2004) then cite the work of Savelsbergh and van der Kamp (2000) who applied these processes to perception.

Savelsbergh *et al.* (2004) provide an excellent description of these processes in more practical terms. When freezing perceptual degrees of freedom, only one

source of information out of the total number of information sources available is chosen to regulate action. As this "coupling" is reinforced through practice, this increases the chances of the same outcome occurring under a similar set of circumstances (referred to as constraints). An example of this is where a soccer player is taught to stop a ball with their foot, when this ball is kicked along the ground and where the conditions are stably maintained (Savelsbergh *et al.,* 2004).

The second phase involves the freeing of the perceptual degrees of freedom whereby practice is performed under various different conditions or constraints. This assists the individual in establishing a collection of different couplings for this specific task. Therefore, as the circumstances or constraints change, so the participant can choose a different coupling or set of actions. To illustrate this progression, the soccer player is now taught to stop a ground-level ball with their foot when the ball is passed along the ground in a different way or when the ground is wet (Savelsbergh *et al.,* 2004).

The final phase involves the exploiting of the perceptual degrees of freedom. The individual who has advanced in skill can now utilise the information received from the environment to either carry out the original skill (stopping a ground-level ball with their foot) but may also use this information to perform other skills such as ball heading or passing the ball with one touch (Savelsbergh *et al.,* 2004).

Essentially, what can be gained from these explanations is as the participant practices their skills and becomes more adept in the execution thereof, their ability to incorporate more of the abundant information cues inherent to the relevant environment presented to them improves and they therefore have a wider array of information/action choices to make a selection from. In this way, skilled individuals are more capable and able to perform motor actions in response to a wider array of informational, perceptual and environmental stimuli.

This much is admitted by Araújo (2007:76) who, when describing the development of expert performance in sport, says that to successfully achieve this *"…requires establishing a link between information and movement in the short term, and refining that link in the long term."*

5.3.2.2 Dynamical systems theory

According to the dynamical systems theory, the execution of physical tasks or movement can be defined as coordinated motor patterns (Thomas *et al.,* 2001) or patterns of movement (Coker, 2004) that self-organise as a reaction to the task-specific constraints inherent to the movement or task (Thomas *et al.,* 2001; Coker, 2004). Thomas *et al.* (2001) provide the best description of the three characteristics that are inherent and unique to the dynamical systems theory. These are that skilled movement is not as a result of maturational processes, that specific internal and external influences cooperate to control movement, and finally, that movement is not cognitively controlled or influenced (Thomas *et al.,* 2001).

According to the dynamic systems theory, there are specific constraints that are inherent to movement. These constraints are commonly divided into three categories and are described hereafter. Once again it needs to be heeded that while a specific study is credited for the specific heading of the constraint, these headings have been found in all the studies:

1)   Task constraints (Araújo *et al.,* 2004:413).
This entails aspects such as the specific tools or implements needed for participation in the sport, the rules of a specific sport, the task goal, and even extends to field markings and the like (Thomas *et al.,* 2001; Araújo *et al.,* 2004; Coker, 2004).

2)   Organismic constraints (Araújo *et al.,* 2004:412).
This refers to the physical aspects of the participant. These include structural characteristics such as body composition and weight as well as the cardiovascular,

neural and muscular systems. Functional characteristics include motivation, emotions and cognition (Thomas *et al.,* 2001; Araújo *et al.,* 2004; Coker, 2004).

3)   Environmental constraints (Araújo *et al.,* 2004:412).

This includes aspects such as gravity, lighting, temperature and can also include the auditory information available to the individual (Thomas *et al.,* 2001; Araújo *et al.,* 2004; Coker, 2004).

With all movement tasks, there are many ways in which to act or move (Thomas *et al.,* 2001). The central tenet of dynamic systems theory is that movement is the result of gaining control over the numerous (mechanical) degrees of freedom that are available to the individual. Through the interaction between these degrees of freedom and the associated constraints (task, organismic and environmental), control can be exerted over the mechanical degrees of freedom that are not required, simple and stable movement patterns can emerge, with effective and proper movement as the result (Thomas *et al.,* 2001; Araújo *et al.,* 2004).

Or, put another way; acquiring and developing movement coordination is a process whereby the redundant or non-essential degrees of freedom are discarded or disregarded, the essential degrees of freedom are constrained, stimulated and controlled, with the resulting movement being more controlled and skilful (Williams & Ward, 2007).

In conclusion of this section; from the literature it is clear that both perceptual-cognitive and perceptual-motor approaches employ different methodological approaches. Whereas perceptual-motor approaches are attuned to perception and subsequent motor action, they give the cognitive aspects of movement very little consideration. Perceptual-cognitive approaches in turn focus on perception and cognition and are not overly concerned with how these decisions are physically implemented (Williams & Ward, 2007).

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But, while Williams and Ward (2007) are of the opinion that it would be very difficult to combine these two approaches, they do make mention of the work of Davids *et al.* (2001) that provides further insight into the attempts made in literature to combine these divergent methodologies. Another example is that of Starkes *et al. (*2004). In describing their model of the acquisition and retention of perceptual-motor expertise, Starkes *et al. (*2004:259) explain that it *"…attempts to capture the constant transition that occurs in perceptual-cognitive and perceptual-motor behaviour as skill acquisition occurs, as well as how skilled behaviours may be retained following peak performance."* In literature reviewed subsequent to their study, commentary on their model was not encountered; although that does not preclude the fact that such commentary probably does exist.

It must be noted regarding the dynamical systems theory that it has been utilised and applied in a variety of different disciplines ranging from biomechanics (Davids *et al.,* 2000; Glazier *et al.,* 2003) to psychology (see preceding references as evidence). The application of this theory to various disciplines is noted, but, the inclusion of this theory within this section is justified by; 1) this theory's close and intimate association and interaction with ecological psychology as well as; 2) the overwhelming evidence garnered from the literature pertaining to sport psychology. Therefore, the dynamical systems theory is a psychological construct in its own right.

5.4   MENTAL TOUGHNESS

To attain the highest levels in elite sport, resilience, perseverance and a "thick skin" are required. Sport is not only about the requisite physical ability and psychological characteristics, attributes and skills such as motivation, commitment and perceptual-cognitive/motor abilities, but, pertinently, it is about having control over conflicting emotions and the ability to properly harness and direct emotions such as aggression, anger, self confidence and even fear.

Within the literature, a relatively recent, all-encompassing construct has emerged, namely that of mental strength and toughness. This construct has received some

interest in rugby (Abbott & Easson, 2002; Luger & Pook, 2004) which is understandable, since, by its nature rugby is a particularly physically taxing and demanding (and aggressive) activity that is often described as being a collision sport (Hattingh, 2003; Gabbett, 2006; Gabbett & Domrow, in press). Also, in reviewing the distinction made by this study and guided by Baker and Horton (2004) between the psychological abilities needed to firstly achieve and then demonstrate high levels of ability in sport, it must be said that mental toughness falls into both categories.

Therefore, mental toughness has a strong influence on excellence in an endeavour such as competitive sport and rugby where incredible demands are placed on participants to excel at the highest levels while performing under physically and mentally demanding conditions (Fourie & Potgieter, 2001; Smith, 2002; Jones *et al.,* 2007). To become a champion, talent is simply not enough; mental abilities and personal characteristics are often the difference between the fine line that separates success and failure (Calder, 2007).

The importance of mental toughness cannot be overemphasized. In the study of Gould *et al. (*2002), 73% of the respondents identified mental toughness as being important to performance. The most notable aspect of this study is that it was performed on a sample group consisting of ten Olympic champions. These champions represented nine Olympic sports and the combined total of the Olympic medals won by these athletes was 32. These medals consisted of 28 gold medals, 3 silver medals and 1 bronze medal. Also included in the study were ten coaches involved in the development of these Olympic champions, as well as ten significant others (one for each athlete). These significant others consisted of siblings, fathers, mothers and one significant other. Therefore, this study represented the "best of the best" and a major implication of this study is that mental toughness is critical to performance in elite sport.

But, as Cooper and Goodenough (2007:1) ask *"What is mental toughness anyway?"*

In referring to the sentiments of Jones *et al.* (2002), Jones *et al.* (2007:244) say that mental toughness is *"…one of the most used but least understood terms in applied sport psychology."* Jones *et al.* (2002; 2007) go on to note that numerous attempts are found in literature that try to define mental toughness or try to describe how to develop mentally tough individuals. They lament the fact that these widely-differing definitions and explanations only serve to cause more confusion.

Perhaps, in an attempt to define mental toughness, the attributes or characteristics thereof need to be considered? Once again the problem of the vagarious nature of this concept is highlighted by Jones *et al. (*2002) who provide a host of studies listing the characteristics of mental toughness; they opine that from the evidence in literature that they reviewed, any desirable or attractive psychological characteristic that assists in achieving success in sport has been considered as being mental toughness.

For the sake of clarity and consistency, the findings of recent studies focussing on mental toughness have been reviewed, with particular reference to these studies' listings of the inherent attributes of mental toughness. Thereafter, and as a conclusion to this sub-section, the findings of two of the most recent publications in literature have been provided and contrasted.

1)   Fourie and Potgieter (2001) define mental toughness as possessing the ability to deal with pressure and hardship, under conditions characterised by high mental and physical demands, in ways that that won't adversely hamper nor have a negative impact on performance. Furthermore, under this competitive pressure, mentally tough athletes remain composed and can continue to think in realistic, positive and productive ways. These authors also note that mentally tough individuals require the ability to remain simultaneously brave and committed, all the while being of good spirits.

The attributes of mental toughness listed in their study include attributes such as psychological hardiness, discipline, competitiveness, goal directedness and preparation skills, motivation, confidence, mental, cognitive and physical ability, coping skills, team unity, and finally, ethics and religiosity. Overall, the athletes considered perseverance as most significant, while the coaches felt that concentration was most important.

2)   Jones *et al. (*2002:209) define mental toughness as *"…having the natural or developed psychological edge that enables you to:*

- *Generally, cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on a performer.*
- *Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure."*

Jones *et al. (*2007) observe that this definition was subsequently cited and endorsed by Bull *et al. (*2005), and Thelwell *et al. (*2005). Both Bull *et al.* (2005) and Thelwell *et al.* (2005) also endorse (with Thelwell *et al.* (2005) citing) the attributes of mental toughness originally proposed by Jones *et al. (*2002) and that are listed hereafter.

The attributes of mental toughness as proposed by Jones *et al. (*2002) are, 1) retaining focus in-spite of life distractions; 2) retaining a task-specific focus in spite of the distractions from competition; 3) not being negatively influenced by others' performances; 4) having a resolute belief in one's ability to succeed and to achieve goals; 5) a belief of superiority over opponent(s); 6) enduring emotional and physical pain during competition and training while still maintaining effort and proper technique; 7) enjoying competition pressure; 8) possessing an unquenchable motivation and desire for success; 9) being able to regain psychological control following unanticipated events during competition; 10) accepting and coping with competition anxiety; 11) the ability to rebound from bad performances and maintaining a resolute determination to succeed, and finally; 12) the ability to turn one's sport focus on and off at the proper times.

3)   Golby and Sheard (2004), in quoting the opinion of Loehr (1986), refer to mentally tough performers as those individuals who are disciplined in their thinking and who are able to calmly respond to pressure and in so doing maintain a relaxed outlook. Also, mentally tough individuals possess the proper attitudes concerning a multitude of issues such as competition, problems and others.

Specifically, they then list Loehr's (1986) original mental toughness attributes as being those of, 1) an unyielding attitude; 2) focused and controlled attention; 3) emotional control over feelings such as frustration, anger and fear and the ability to cope with events that are out of one's control; 4) positive visualisation and imagery; 5) enjoyment and fun; 6) self-confident in the knowledge that one can be successful, and; 7) perseverance and motivation.

Furthermore, the studies of both Bull *et al.* (2005) and Thelwell *et al.* (2005) are highly informative and of great value in further expanding the concept of mental toughness.

5.4.1   Recent studies on mental toughness

It is the more recent study of Jones *et al. (*2007) and the work of Cooper and Goodenough (2007) that provide the most relevant information on this construct and these are reviewed in this section.

5.4.1.1 Mental Toughness Framework (Jones *et al.,* 2007)

In a follow-up on their study in 2002, Jones and colleagues (2007) attempt to develop a mental toughness framework for sport. The subsequent results of their study are most helpful. While their latest study endorsed the definition of mental toughness in their previous work in 2002, they were in fact successful in developing a mental toughness framework with their recent work.

Their sample group consisted of eight *super-elite* (those falling into this category are recognised officially as being the best in the world) sports participants who between

them had amassed eleven world championship titles and seven Olympic gold medals. The sports represented in the sample were athletics, cricket, pentathlon, squash, rugby union, judo, boxing, triathlon, swimming and rowing. Also included in the sample were sport psychologists and coaches, all of whom had experience in dealing with super-elite athletes.

The mental toughness framework of Jones *et al.* (2007) is a valuable tool in examining and developing this construct. It is made up of four main dimensions, but contains thirty attributes that are assigned and ranked under these dimensions. This framework is described briefly hereafter, but no specific rankings are provided. Furthermore, the attributes described are in summarised form, in no particular order. For an in-depth review of the rankings, please consult the original study:

1)   Attitude/mindset dimension (Jones *et al.,* 2007:250)
This contains two subcategories, i.e.: focus and belief.

1.1) The focus subcategory highlights the following attributes: making the number one priority in your life that of achieving your sport's goal, the ability to switch on and off in life, and a focus on long-term goals as opposed to short-term gains.

1.2) In the belief subcategory the following attributes are encountered: the belief that any obstacle can be overcome, the belief that intense desire and hunger will result in the fulfilment of potential, and an unwavering belief in self, and a remembrance of path travelled to success (Jones *et al.,* 2007).

2)   Training dimension (Jones *et al.,* 2007:250)
This has three subcategories, i.e.: control of the environment, pushing oneself to the limit and using long-term goals as motivation.

2.1) The controlling of the environment subcategory has the following attributes: use a difficult training environment or circumstance to one's own advantage, and not being controlled, but remaining in control.

2.2) In the subcategory of pushing oneself to the limit, the following attributes are encountered: Opportunities presented in training to beat other people must be used to the fullest benefit, and enjoying training that hurts.

2.3) In the long-term goals subcategory the following attributes are noted: to keep reminding oneself of your goals and desires when training gets physically and mentally tough and to have the patience and self-discipline required when training for each developmental stage (Jones *et al.,* 2007).

3)   Competition dimension (Jones *et al.,* 2007:251)

This dimension has six subcategories, i.e.: regulating performance, belief, staying focused, handling pressure, controlling the environment and awareness and control of thoughts and feelings.

3.1) In the regulating performance subcategory, the following attributes are noted: raising one's performance when needed, and being able to take advantage of the key moments in competition (possessing a "killer instinct").

3.2) In the belief subcategory, the following attributes are found: rebounding from mistakes and remaining committed to the performance goal until the very end.

3.3) The staying focused subcategory contains the following attributes: retaining a self-absorbed focus in the face of external distractions, being totally focused on the job at hand in spite of distractions, and focusing on processes as well as outcomes.

3.4) The handling pressure subcategory lists the following attributes: correct decisions and choices of options or alternatives for the best performance under

pressure, coping with changes under competition pressure, loving competition pressure, and coping with anxiety in pressure circumstances.

3.5) In the controlling the environment subcategory, the following attributes are found: utilising all the aspects of a challenging competition environment to one's own advantage.

3.6) The awareness and control of thoughts and feelings subcategory has the following attributes: being conscious of wrong or damaging thoughts and feelings and adjusting them to perform at one's best (Jones *et al.,* 2007).

4)   Postcompetition dimension (Jones *et al.,* 2007:251)
This contains two subcategories, i.e.: handling success and handling failure.

4.1) In the handling of success subcategory, the following attributes are provided: knowing how to handle success in a rational manner, and knowing when to celebrate your successes and victories but then also knowing when to stop and to refocus.

4.2) In the handling of failure subcategory, the following attributes are given: using failure as a motivation towards achieving further success, and rationalising and learning from failure (Jones *et al.,* 2007).

As can be seen, Jones *et al. (*2007) have provided a comprehensive framework that can be used to further describe mental toughness as well as to assist in the development of mental toughness.

5.4.1.2 Elite Athlete Development Model (Cooper & Goodenough, 2007)
This Elite Athlete Development Model of Cooper and Goodenough (2007) (also called the "Zoning Pyramid") is a valuable tool not only to ascertain the current mental status and level of toughness in an individual, but furthermore, to assist in

developing mental abilities so as to improve and develop these in the individual (and possibly the team where applicable). This model is best described as follows:

The Elite Athlete Development Model offers a substantially different perspective to that offered by the traditional sport psychology approaches, and is based on the concept of Meta-Coaching. Meta-Coaching is in turn based on several neuro-semantics models, principally the Meta-States Model, the Matrix Model and the Axes of Change. These models come from the fields of developmental psychology, cybernetics, general semantics, neuro-linguistic programming (NLP), cognitive behavioral sciences, cognitive linguistics, neuro-sciences, and system dynamics. As a result, neuro-semantics can largely be seen is an inter-disciplinary field. In 1994, L. Michael Hall, Ph.D., developed the first and core model of neuro-semantics, called the Meta States Model. Neuro-semantics is a newer, more modern extension of NLP and has added a new level of professional ethics (M. Cooper, personal communication, 2007).

Accordingly, this model is perfect for the sporting arena, since it allows for generative mental development to occur and further allows for attention to be focused on working on what the athlete wants to develop. This is in contrast to traditional psychology that primarily focuses on remedial mental work. Therefore, according to this model, coaching assumes that a client is a talented and fully functioning individual that will benefit from developing new behaviours, skills and learning's through a facilitative process that is non-directive. This non-directive facilitation is aimed at the client or sports person being guided to find their own unique strategies and learning's to build the 13 skills that make up this Elite Athlete Development Model by Cooper and Goodenough (2007) (M. Cooper, personal communication, 2007).

In sport there are common questions asked regarding mental strength and toughness. Questions are frequently asked regarding the behaviors that coaches should look for in new athletes so as to determine their potential in sport, or, the

specific steps that need to be taken to improve mental strength and toughness (M. Cooper, personal communication, 2007). The Elite Athlete Development Model of Cooper and Goodenough (2007) breaks down "mental strength" into thirteen specific foundational skills and then provides benchmarks for these skills (M. Cooper, personal communication, 2007; Cooper & Goodenough, 2007).

These benchmarks allow the coach to measure each skill on a scale from zero to five. The athlete can receive feedback on specific strengths and weaknesses and then have targeted coaching sessions to develop these skills. The advantage of this model lies in the fact that these skills can be measured, allowing this model to be used as an assessment tool. Athletes benefit from being able to be coached immediately on their areas requiring specific attention. What this means for sports participants (teams and individuals) is that the positive impact on performance will be quicker than what would normally be expected were these unique interventions not applied (M. Cooper, personal communication, 2007).

The thirteen skills were built on interviews with former and current South African elite athletes and can be regarded as a model of excellence. These thirteen skills of the Elite Athlete Development Model of Cooper and Goodenough (2007) are listed and briefly described hereafter:

1)   Performing from one's highest intentions (Cooper & Goodenough, 2007:223)

Associated with this is the main reason for one's participation in a sport or activity. This provides the impetus to continue within a sport or activity.   It entails being able to know and to identify as well as to operate from the intentions that one has. It also entails the ability to move towards one's highest intentions (Cooper & Goodenough, 2007).

2)   Strong work ethic (Cooper & Goodenough, 2007:225)

This entails being able to put in regular and sustained hard work and effort to reach one's goals. It also entails goal setting ability as the ability to see these goals through (Cooper & Goodenough, 2007).

3)   Internally referent (locus of control) with external check (Cooper & Goodenough, 2007:227)

Makes decisions and thinks, based on what one knows, understands and believes. This decision making process can entail checking with others, but is primarily geared toward a ratio of twenty five percent external focus and a seventy five percent internal focus (Cooper & Goodenough, 2007).

4)   Clear distinction between self-confidence and self-esteem (Cooper & Goodenough, 2007:230)

This is the ability to distinguish between one's skills and ability to perform, which is self-confidence, and one's value and worth, which is self-esteem (Cooper & Goodenough, 2007).

5)   Resilience (Cooper & Goodenough, 2007:233).

This entails the ability to rebound from a bad performances or setbacks in a short period of time and to not hold on to the negative associations of these setbacks but to learn the inherent lessons contained in the setbacks. This also entails the ability to successfully cope with negative life events that hamper or hinder performance or progress (Cooper & Goodenough, 2007).

6)   Effectively manages anxiety and confidence (Cooper & Goodenough, 2007:235).

This means that one is able to manage and balance the to-and-fro effect that anxiety and confidence can have on an individual and on performance (Cooper & Goodenough, 2007).

7)   "Un-insultability" (Cooper & Goodenough, 2007:237).

This means possessing a strong sense of self that views both criticism and support as things that don't affect self esteem or perception (Cooper & Goodenough, 2007).

8)   Mental positioning (Cooper & Goodenough, 2007:239).

This is the ability to have or to adopt different perspectives on the game or event and to understand one's own specific role within the game and to fulfill it. Furthermore, this also entails being able to disassociate oneself from the game to monitor its progression (Cooper & Goodenough, 2007).

9)   Engages in meaningful and high-quality practice (Cooper & Goodenough, 2007:241).

To approach practice and training in practical ways that develop skills and that help with achieving goals but that also promotes team building and motivation. This also means that this practice should stimulate a sense of consistent improvement. Also, practice should be complementary to the specific goals of the player (Cooper & Goodenough, 2007).

10)   Quality mental preparation before an event (Cooper & Goodenough, 2007:243).

This is the ability to effectively use visualisation techniques that effectively capture the anticipated match environment and that suitably prepare the mind and body (Cooper & Goodenough, 2007).

11)   The ability to simplify (Cooper & Goodenough, 2007:245)

The ability to identify the "critical success factors" required to be competitive from one's own understanding of the game (Cooper & Goodenough, 2007).

12)   Activity identity-shaper (Cooper & Goodenough, 2007:247)

One's ability to choose a self identity that is initiated and empowered from within. This self identity assists in achieving one's goals and (maximum) potential (Cooper & Goodenough, 2007).

13)   Flow state management (Cooper & Goodenough, 2007:249).

This entails being "in the zone" and the ability to at will enter into a state of utmost involvement or engagement with an activity or experience. To be able to "switch" this ability or "zone" on or off at will. Cooper and Goodenough (2007) acknowledge the work of Csíkszentmihályi (1991) in this regard (Cooper & Goodenough, 2007).

Therefore, in conclusion of this sub-section, every one of the thirteen skills listed is then benchmarked on a scale from zero to five. Once this benchmarking is complete, the process of improving these scores through coaching can commence. But, pertinent to remember is that this model can be used as an assessment tool, hence the value and appeal of this model to talent identification and development.

5.5   SUMMARY AND APPLICATION TO TALENT IDENTIFICATION AND DEVELOPMENT

The discussion serves as a summary of this chapter and will focus on three issues:

1)   The interrelation of the psychological and mental skills, attributes and abilities mentioned examined throughout the course of this chapter. In particular, the relevant and possible influence that these skills and abilities have on one another, as well as their possible impact on talent identification and development are considered.

2)   A review of the possible incorporation of the Mental Toughness Framework of Jones *et al. (*2007) and the Elite Athlete Development Model of Cooper and Goodenough (2007) into the talent identification protocols and subsequent development processes.

3)   A discussion centering on the possible inclusion of perceptual-cognitive and perceptual-motor skills tests in the talent identification protocols and processes.

5.5.1   Interrelation of psychological skills, attributes and abilities

From the literature reviewed in this chapter, the different constructs, theories, attributes and skills seem to vary with regards their application and relevance, but, it is clear that they have an influence and impact on one another in various manners.

5.5.1.1 Motivation, commitment, practice and enjoyment

When considering task and ego-orientations as well as intrinsic and extrinsic motivations as promoted by the Achievement Goal Theory (AGT), the Profile of Goal Orientation Questionnaire (PGOQ), the Self Determination Theory (SDT), The Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM) and the Elite Athlete Development Model (EADM) respectively, it is obvious that a balance between these orientations and motivations is needed to reach elite status in sport. This much is confirmed by Van Rossum and Vergouwen (2003) in Van Rossum and Gagné (2005), who, in their study on Dutch, South African and Australian national field-hockey teams found results implying that both the ego and task aspects of sport achievement motivation are judged to be important or of value by elite athletes.

As an illustration of this fact; as part of their Mental Toughness Framework (MTF), Jones *et al. (*2007:250) propose in their in subcategory of *"…pushing yourself to the limit"* that in practice one must enjoy the opportunities presented to beat other individuals. It can be deduced from this that practice can (and should?) be considered a competition "dress-rehearsal" and therefore practice, training and competition require both task-and-ego-orientations as well as intrinsic and extrinsic motivations for these competitive endeavours to be successful.

This consideration applies especially to sports that require direct opposition to train. In wrestling, as reflected by Hodges and Starkes (1996), an individual is required to train against another individual. It stands to reason that in sports such as these, technique development is so dependent on these direct one-on-one training sessions. The assumed requirement of this kind of training is that a task/intrinsically focused perspective is needed to improve personal technique and that an ego/extrinsically focused perspective is needed in training (and competition) to beat

the opposition. In fact, it is quite hard to imagine a sport where practice against opposition is not a prerequisite and where a certain amount of ego or extrinsically focused perspective is not required. Although, most of the models do insist that competitors must not be affected by their opposition and must maintain an inward, task orientated focus. But, the point remains that ego orientation is at least a part necessity.

Furthermore, in team settings this aspect is an even greater consideration. Not only does one have to concentrate on their own technique, but also the movements and patterns of their teammates and the opposition. This can be applied to most team sports and most certainly rugby; in training (simulated competition environments) and competition, while focus on own technique is vital, focus on teammates and the opposition is critical. The facts are clear; to become a champion (individually or as a team) you must beat the opposition.

To confirm the above sentiments, it was found by Baker *et al. (*2003b) that competitive settings (such as organised games) were the most valuable in developing and training aspects of performance such as decision-making and perception. The conclusion is made by this study, then, that it is undeniable that there is an inevitable or even a required amount of external focus and motivation needed to be successful or to become a champion.

Pertaining to the Deliberate Practice Theory (DPT) of Ericsson *et al. (*1993) (DPT), of the constraints listed by their theory is that a high level of effort is required so sustain this kind of practice, and that practice is not deemed inherently enjoyable. It is said that that motivation and *"…ones intent to improve"* (Ward *et al.,* 2004:232) play an important role in sustained practice and participation. This study holds to the position that motivation characterised by a more task-orientated goal perspective and biased toward intrinsic motivation is critical to persist in this kind of training.

When elaborating on the DPT further by considering the EADM, one of the skills mentioned is that of *"Performing from one's highest intentions"* (Cooper & Goodenough, 2007:223). This refers to one's main reason for participation as well as the impetus to continue in a sport or activity. Since the intention of deliberate and sustained practice is the improvement of skills, in a way this can be seen as a higher or the highest intention as proposed by EADM.

Furthermore, regarding enjoyment in practice; there seems to be a disparity regarding the role of enjoyment in sport participation and practice as proposed by the Sport Commitment Model (SCM) of Carpenter, Scanlan and colleagues (1993) in contrast to the Deliberate Practice Theory of Ericsson and colleagues (1993) which states that practice is not inherently enjoyable.

Even if Ericsson *et al. (*1993) propose that practice by its nature not enjoyable, other studies (Carpenter *et al.,* 1993; Scanlan *et al.,* 1993a, 1993b; Carpenter & Scanlan, 1998; Starkes *et al.,* 2001; Ward *et al.,* 2004; Hyllegard & Yamamoto, 2005; Weiss & Weiss, 2007) on sport and the construct of enjoyment in deliberate practice and sport participation and commitment have come up with contrary findings, suggesting that in the domain of sport, enjoyment of participation is integral to sustained adherence and success.

5.5.1.1.1   Commonalities

As a summary of the commonalities of the psychological and mental attributes discussed in this chapter, the following commonly encountered attributes apply: 1) work ethic, practice, motivation and goal setting (Jones *et al.,* 2002; AGT; DPT; HMIEM; EADM; MTF; PGOQ; SDT); 2) anxiety and self-confidence (Fourie & Potgieter, 2001; Jones *et al.,* 2002; Golby & Sheard, 2004; EADM; MTF); 3) resilience, commitment and hardiness (Fourie & Potgieter, 2001; Jones *et al.,* 2002; Golby & Sheard, 2004; EADM; MTF; SCM); 4) mental preparation and visualisation (Golby & Sheard, 2004; EADM), and; 5) attention and focus (Jones *et al.,* 2002; Golby & Sheard, 2004; EADM; MTF)

Therefore, it is clear that all aspects of motivation, commitment, practice and control over emotions play an important role in most of the studies, models and theories presented in this review, and therefore they can be regarded as being interrelated on this level.

As confirmation if this, the uniquely South African study of Schuman *et al.* (2005) is presented. In this study, 454 sports participants and 114 coaches were interviewed regarding the importance of motivation and related factors in sport. The following mix of intrinsic and extrinsic motivational, commitment-related and enjoyment factors were identified by Schuman *et al.* (2005:143) as being important in motivation: *"…encouragement to perform better; goal setting; enjoyment and pleasure in sport; activation; self-efficacy; communication between coaches/players; reward for achievement; self confidence in players; praise; individual attention; effective coaching methods and techniques; competition; and being intrinsically motivated."*

This study of Schuman *et al.* (2005) could very well be viewed as a summary of the whole preceding discussion in this chapter.

5.5.1.2 Role of practice in perceptual-cognitive and perceptual-motor skills

5.5.1.2.1   Practice and perceptual-cognitive skills
The perceptual-cognitive advantages experienced by elite athletes over non-elite athletes in the procedural, declarative and strategic domain and sport-specific knowledge that they possess (French & McPherson, 1999; Helsen & Starkes, 1999; Kluka, 1999; Starkes *et al.,* 2001; Thomas *et al.,* 2001; Janelle & Hillman, 2003; Hodges *et al.,* 2006), as well as their advantage over lesser skilled players in pattern or information recall, retention and recognition abilities (Williams *et al.,* 1994, 2003, 2004; Helsen & Starkes, 1999; Tenenbaum *et al.,* 1999; Williams, 2000; Starkes *et al.,* 2001; Baker *et al.,* 2003b; Lyoka & Bressan, 2003; Ward & Williams, 2003; Williams & Ward, 2003, 2007; Abernethy *et al.,* 2005; Hodges *et al.,* 2006; Vaeyens *et al.,* 2007) has been well documented.

Prolonged exposure to a domain is vital for these skills to be developed and improved, with deliberate and persistent practice contributing to this process. Therefore, from the evidence presented above and before, practice assists with training perceptual-cognitive skills such as sport-specific knowledge and pattern recall and recognition. The role of practice in the other perceptual-cognitive skills and abilities was also considered.

Aspects such as practice and improving anticipation through improving advanced cue utilization (Williams & Ward, 2003; Williams *et al.,* 2003, 2004) and practice and visual search behaviours and strategies (Vaeyens *et al.,* 2007) were studied with certain practice effects found. Other aspects such as pattern recognition and situational probabilities have received little attention as such (Williams & Ward, 2003; Williams *et al.,* 2004).

5.5.1.2.2   *Practice and perceptual-motor skills*

As was demonstrated, practice is critical to the process of educating attention where perceptual-motor abilities are improved by a process where perceptual information is frozen and subsequently freed and exploited (Savelsbergh *et al.,* 2004; Williams & Ward, 2007).

When considering motor skills and movement, it can be said that movement is the result of gaining control over the numerous (mechanical) degrees of freedom that are available to the individual. Through the interaction between these degrees of freedom and the associated constraints (task, organismic and environmental), control can be exerted over the mechanical degrees of freedom that are not required, simple and stable movement patterns can emerge, with effective and proper movement as the result (Thomas *et al.,* 2001; Araújo *et al.,* 2004). It is once again quite obvious that practice is essential in promoting the gaining of control over the degrees of freedom and would be paramount to both assist and adjust to the constraints inherent to movement within the specific context.

While it is debatable within the literature as to whether practice can assist with visual system improvement, some limited evidence of this fact has been presented (Meir, 2005; Cooper & Goodenough, 2007).

5.5.1.2.3   Practice and skill transfer

Evidence of a transfer effect in hand-eye coordination was found by du Toit *et al.* (2006a) and Grassi *et al. (*2006), underscoring the important role of practice in developing these perceptual-motor skills.   But, limited evidence of role-specific perceptual-cognitive skill transfer (Smeeton *et al.,* 2004; Abernethy *et al.,* 2005; MacMahon *et al.* 2007) has also been encountered. This study adopts the position that it is certainly feasible that practice assisted in developing the perceptual-cognitive skills in the initial role or domain, and that it was these practiced skills that transferred between the similar roles found in the preceding studies.

5.5.1.3 Impact of the interrelatedness on talent identification and development

The impact of the interrelatedness of these factors on talent identification and development is vast. Talent identification more often than not identifies those individuals in possession and currently applying the abilities, attributes and skills mentioned in this section. But, importantly, by identifying those in possession of these factors, talent identification can assist in the further development of the individuals in these factors and others.

For example, motivation, commitment, practice and mental toughness could have, in all likelihood, contributed to the individual developing their perceptual-cognitive and perceptual-motor abilities so that these aspects, in conjunction with well developed physical aspects, place the individual in a favourable position to be identified or selected. Thereafter, they stand the good chance of being included in further developmental programs that improve these abilities even more. The process can therefore be regarded as a closed-loop system, i.e.: complementary and most certainly reciprocal.

In sum: from the preceding passages, it is clear that talent identification should acknowledge the likelihood that the interrelations of these factors have assisted in the previous development of those individuals to the point where they are currently identified or selected for further development.

Of course, these sentiments are not shared by everyone, as chapter four and six show. Aspects such as early physical maturation, practice and others (chapter four) and the perceived inadequacies of current talent identification approaches (chapter six) are issues that are consistently highlighted as being complicating factors within the field of talent identification.

And there are other considerations in this regard, like those of Morris (2000) and Williams and Reilly (2000b). These authors are of the opinion that there are no specific personality profiles that exist within sport and that can predict future achievement. With that said, it is the opinion of this study, however, that the Elite Athlete Development Model (EADM) of Cooper and Goodenough (2007) and the Mental Toughness Framework (MTF) of Jones *et al.* (2007) have gone a long way in providing at least some semblance of assessment, with the EADM more so. These sentiments are further elaborated upon next.

5.5.2 Incorporation of mental toughness measures in talent identification protocols

Jones *et al. (*2007) propose their impressive Mental Toughness Framework by which the elements and attributes of mental toughness and strength have been exhaustively researched and described. This model serves to identify and develop these aspects and attributes within the individual. In theory, this framework can be used to search for these characteristics within individuals.

But, to what extent can these attributes be objectively measured and further developed?

The specific views of Williams and Reilly (2000b) are that while studies have shown that aspects such as mental toughness and aggression have been found to be the difference between successful and less successful participants, there are concerns with the methodological aspects arising from these studies.

But, this study's view on these proposals of Williams and Reilly's (2000b) is one of respectful disagreement. Abbott and Easson (2002) provide a simple and straightforward, rugby specific performance profiling model developed by Butler (1996) that measures not only physical parameters and technical aspects of a rugby player but also psychological skills and attitudes that can be seen as pertaining specifically to mental toughness. This profiling takes the form of self assessments that are valuable because not only does it provide for the assessing of individual players but also provides that individual players assess themselves. This can lead to accountability and self-responsibility for the improvement of these factors. This performance profiling model could quite successfully be used in talent identification protocols and practices. Furthermore, Abbott *et al.* (2007) provide evidence of studies finding that aspects such as commitment, goal setting and imagery have all been found to differentiate between more and less successful sports participation.

It is therefore this study's contention that the Elite Athlete Development Model of Cooper and Goodenough (2007) can successfully be incorporated into talent identification and selection protocols, and can further be highly effective when incorporated into talent development programs. This model measures all of these differentiating aspects mentioned by Abbott *et al.* (2007), and more. Furthermore, while this model can present your current profile with regards to how you score in each of the thirteen categories, it can also show you what to do to improve. The Mental Toughness Framework of Jones *et al.* (2007) is also an option, but, it is not as much of an assessment tool as the model of Cooper and Goodenough (2007).

That a mental toughness assessment tool is needed is a concession that Jones *et al.* (2007:262) make when they admit that *"…there is a need to develop a valid and*

reliable measure of mental toughness based on a sound knowledge base of dedicated empirical research.” They do however state that the findings of their study could assist in developing such a tool. Whether Cooper and Goodenough's (2007) model meets the requirements of having a solid empirical research base seems to be a moot point in this case. From what they have provided through their interviews and further implementation of aspects from many complementary fields, as well as their own, and with these fields having an assumed satisfactory empirical base, their model is certainly exhaustive, robust and complete.

5.5.3 Recommendations regarding the inclusion of perceptual-cognitive and perceptual-motor tests within talent identification protocols

Williams and Reilly (2000b) are strong supporters for the possible role that perceptual-cognitive skills can play in talent identification. A number of studies and texts have reviewed the common methods and techniques used to measure and evaluate perceptual-cognitive and perceptual-motor abilities in sport. These methods are evaluated hereafter:

5.5.3.1 Film and video-based simulations, virtual reality and field-based methods

Film and video-based simulation methods have been used to accurately capture performance in sport (Williams & Ericsson, 2005; Hodges *et al.,* 2007; Ward *et al.,* 2006; Williams & Ward, 2007). The advantage of using film or video simulators is that these methods can consistently and accurately reproduce action sequences and in so doing facilitate proper and objective measurement of performance (Williams & Ericsson, 2005; Williams & Ward, 2007), with Ward *et al.* (2006) stating that recent improvements in the technology used for these methods have allowed researchers to improve the "ecological representativeness" of the tasks under investigation.

Virtual reality or field-based methods have also been used (Williams & Ericsson, 2005; Ward *et al.,* 2006; Hodges *et al.,* 2007; Williams & Ward, 2007), but there are questions as to whether virtual reality or field-based methods provide the same level

of benefit or advantage over film and video-based methods (Williams & Ericsson, 2005; Williams & Ward, 2007). Delays in action-response times of the virtual reality system (Hodges *et al.,* 2007) are also a disadvantage of this method.

There are some common methods and techniques that have been used in these perceptual-cognitive to quantify or measure the performance response. These include verbal and written responses, pressure sensitive mats, joysticks and even voice activated responses (Ward *et al.,* 2006; Hodges *et al.,* 2007). But, according to Williams and Ericsson (2005) and Williams and Ward (2007), the most common measures to measure performance are those of, 1) eye-movement recording and visual occlusion techniques, and; 2) protocol analysis (also used during or subsequent to live game or task scenarios). While Williams and Ericsson (2005) do make mention of other methods, the specific focus on the afore-mentioned examples as provided by Williams and Ward (2007) will guide this analysis.

5.5.3.1.1   Eye movement recording and visual occlusion techniques (Williams & Ward, 2007).

The systems used to evaluate abilities such as visual search strategies range from high speed cameras, eye-movement technology and head tracking devices. As with all technology there are cost implications involved, although this technology has become more affordable of late (Hodges *et al.,* 2007).

It has been determined that strategies such as gaze fixation on certain body regions, the length of these fixations and visual search paths are employed by elite performers. The specific findings of these studies are that experts generally employ less eye fixations than non-experts, but that this is also highly specific to the sport involved, where studies have also shown more eye fixations and altered search strategies in experts in different situations (Hodges *et al.,* 2006, 2007). Also, it has been found that the circumstances dictate the search strategies and eye fixations employed by experts (Vaeyens *et al.,* 2007).

Spatial (removing specific events or features in a display) and temporal (removing vision at specific times in the execution of an action) occlusion techniques are also used to measure the ability of elite performers (Hodges *et al.,* 2006). Specific findings indicate that experts can determine from the body or postural cues of opponents, and even from the moments before contact with a racquet, volleyball or a football, what the intentions of these opponents are, and they can make adjustments to successfully attend to the required task or response (Abernethy & Russell, 1987; Starkes *et al.,* 2001; Williams *et al.,* 2004; Hodges *et al.,* 2006; Williams & Ward, 2007). Finally, occlusion under live conditions has also been attempted, but this is not always practical and there are other ethical, methodological and safety concerns (Hodges *et al.,* 2007).

5.5.3.1.2   *Protocol analysis (Hodges et al., 2007)*

It is the important work of de Groot (1978) where the study participants (world's best players and club level players) were required to think aloud while selecting chess moves, that is widely regarded as being of the earliest prominent expertise studies employing and promoting this method (Ericsson, 2006b; Feltovich *et al.,* 2006; Hodges *et al.,* 2007). Participants are required to think aloud and in so doing provide a verbal description of what they are thinking while solving the problems and performing the tasks presented to them (Gordon, 1992; Ericsson, 2003b, 2006b; Van Gog *et al.,* 2005; Feltovich *et al.,* 2006; Schraagen, 2006; Hodges *et al.,* 2007).

Protocol analysis has been shown to not affect the structures underpinning the thought processes (Ericsson, 2003b; 2006b), and in so doing is effective in combating the issue of reactivity, wherein the process of the verbal report generation negatively affects the cognitive aspects that are responsible for the performances observed (Ericsson, 2006b). In essence, what gets reported is what gets observed. Furthermore, the aim of protocol analysis is to determine the declarative and procedural knowledge of an individual (Gordon, 1992; Hodges *et al.,* 2007).

Two techniques of protocol analysis are generally used. These are; 1) retrospective reporting where participants are requested to verbalise their thoughts processes immediately after completion of the task, and ;2) concurrent reporting where the participants are required to verbalise their thought processes while actively busy with the problem or task (Van Gog *et al.,* 2005; Hodges *et al.,* 2007).

As mentioned earlier, protocol analysis has been used within film and video-based simulation tasks (Ward *et al.,* 2006; Williams & Ward, 2007). But, it can also be used successfully in live sport and game scenarios, as was shown earlier (Ericsson, 2003b; McPherson & Kernodle, 2003, 2007; Hodges *et al.,* 2007). In some sport-related examples of protocol analysis, during tennis live games the players were required to verbalise their thoughts between and immediately after points. This revealed the thought processes that go into dealing with the current task as well as monitoring one's own and the opposition's performance throughout the task (McPherson & Kernodle, 2003, 2007; Hodges *et al.,* 2007).

5.5.3.2 Recommendations for the inclusion of these methods in talent identification protocols

The specific conclusions of Williams and Reilly (2000a) are that decision making and anticipation are required for success in soccer, with Abbott *et al.* (2007) agreeing that these factors have been shown to be significant in the differences found in performance between top players and those not at the same level. Williams (2000) go on to state that perceptual skill is a discriminating factor between more and less skilled soccer players.

In considering the inclusion of these methods in talent identification, there are practical and financial concerns; especially surrounding simulator and film-based methods. Sport, and in particular rugby, is anything but repetitive and an in-depth analysis as to the relevant scenarios mimicking or relevant to the demands of rugby would be required. This study has doubts that this would be possible.

Protocol analysis has been used as part of the process of task analysis in establishing and developing adequate talent identification test batteries and protocols, but, as a tool in measuring cognitive abilities and processes this method does hold merit. By using concurrent and retrospective protocol analysis in real-life scenarios, the thought processes of elite vs. non-elite performers could be compared to see if any notable differences that discriminate between talented and less talented individuals can be identified.

No eye-movement tracing or visual occlusion techniques were encountered in actual talent identification protocols for rugby in literature, although in soccer Vaeyens *et al.* (2007) suggest that the perceptual-cognitive tests used by their study could be used to differentiate talented from less talented players. Eye-movement tracing and visual occlusion techniques are once again associated with film and simulator based methods, highlighting the practical and financial considerations of these practices and methods. That they are used is undeniable; that they can be effectively used in mass talent identification and subsequent development processes is questionable.

This current study attempted to include perceptual-motor and perceptual-cognitive ability tests in the form of the Accuvision1000 proaction-reaction test. This was successfully accomplished, with norms established. Other studies such as du Toit *et al. (*2006a) on rugby and du Toit *et al. (*2006b) on cricket have also successfully incorporated the Accuvision1000 into their larger testing protocols. Subsequently, use of the Accuvision1000 has been questioned, but, the view is adopted that this study may very well have provided some of the first, albeit tentative steps toward the inclusion of perceptual-motor (cognitive) based testing in talent identification protocols in rugby. On the whole, the multivariate/multidisciplinary approach of including and considering psychological attributes, skills, perspectives and variables in all forms, in conjunction with physical/physiological, anthropometrical and skills tests in talent identification protocols is the best approach and therefore this status quo needs to be maintained.