The Identification of the Distinguishing Perceptual-motor Characteristics of Top-level Sport Performers

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Declaration

I, the undersigned, hereby declare that the work contained in this dissertation is my own original work and that I have not previously in its entirety or in part, submitted it to any university for a degree.

Abstract

The purpose of this study was to identify the perceptual-motor performance characteristics that distinguish top-level basketball performers from "the rest". Previous research has focused on comparing novices with skilled players in performing different tasks in laboratory settings. The current study was based on a paradigm shift in research that is focused on the study of expertise in applied contexts. A qualitative approach was used in which six expert basketball coaches participated in long interviews. They had all been basketball players before they became coaches. All had been coaching for more than 10 years. One coach was from Africa, one from Europe and four from the United States. Inductive content analysis of verbatim transcriptions was used to generate themes. Quotes from the interviews formed the basic unit of analysis. The emerging themes, higher order themes and categories related to perception, decision-making and motor performance were used to answer research questions. Results of the analysis identified the following characteristics:

- Visual memory, visual anticipation, speed of visual search and peripheral vision.
- Memory, anticipation and cognitive knowledge, i.e. rules of the game and applied knowledge.
- The ability to exchange in deliberate practice for a sustained number of years.

Key Words: Expertise, Perceptual-motor skills, High performance sport

Opsomming

Die doel van hierdie studie was om die persepsueel-motoriese prestasie kenmerke te identifiseer wat topvlak basketbalspelers van "die res" skei. Vorige navorsing het op die vergelyking tussen onervare en ervare spelers gefokus deur verskeie take wat in laboratoriums uitgevoer is. Die huidige studie is gebaseer op 'n paradigma-skuif met die fokus op die studie van kundigheid in toegepaste kontekste. 'n Kwalitatiewe benadering is gebruik waartydens ses kundige basketbalafrigters aan lang onderderhoude deelgeneem het. Al hierdie afrigters was eers basketbalspelers voordat hulle begin afrig het. Hulle almal rig al vir meer as 10 jaar af. Een afrigter was van Afrika, een van Europa en vier van die VSA. Induktiewe inhoudsanalise van woordelikse transkripsies is gebruik om temas te genereer. Aanhalings uit die onderhoude het 'n basiese eenheid van die analise gevorm. Die temas wat ontstaan het, hoër orde temas en kategorieë, wat verband hou met die persepsie, besluitneming en motoriese prestasie, is gebruk om navorsingsvrae te beantwoord. Die volgende kenmerke is met behulp van die uitslae van die analise geïdentifiseer:

- Visuele geheue, visuele antisipasie, spoed van visuele soektog en perifere visie.
- Geheue, antisipasie en kognitiewe kennis, d.w.s reëls van die spel en toegepaste kennis.
- Die vermoë om vir 'n aantal jare met volghoue oorgawe te oefen.

Sleutelwoorde: Kundigheid, Persepsuele motoriese vaardighede, Elite sport

To my wife, My Children and my Mama that missed me for two years; I thank you for your daily prayers.

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Philemon Andrea Lyoka December 2001

Chapter One

Setting the Problem

The study of expertise in sports and games began in the 1970's and as such is a relatively new field of research in sport science. One of the first studies was completed by de Groot (in Chase & Simon, 1973), who studied the thought and choice patterns of master chess players to find out the structure of their memory. As a follow-up study, Chase and Simon (1973) attempted to describe the perceptual structures of master and novice chess players. The authors found that there was a hierarchical organisation of chunked information following a short exposure to different game situations among the expert players. They concluded that the organisation of the memory structures of the master chess players was related to their skilfulness in playing the game.

The research of Chase and Simon (1973) triggered interest from other scholars that led to research about the nature of expertise from several different academic perspectives. Within sport psychology, research from a general perspective has focussed on the relationship between cognitive process and skill execution (Starkes, 1993; Starkes & Allard, 1993; Ericsson & Charnes, 1994; Thomas & Thomas, 1994; French, Spurgeon & Nevett, 1995). Research from a sport specific perspective has also been completed:

- Basketball (Bard & Fleury, 1976; French & Thomas, 1987; Kiomourtzoglou,Michalopoulou, Kourtessis & Derri, 1998a Kiomourtzoglou, Michalopoulou, Kourtessis, & Kourtessis , 1998b; Starkes, Allard, Lindley & Reilly, 1994).
- Volleyball (Starkes & Allard, 1983).
- Handball (Lidor, Argov & Daniel, 1998).
- Tennis (Goulet, Bard & Fleury, 1989; McPherson, 1993; McPherson & French, 1991).
- Athletics (Vernacchia, McQuire, Reardon & Templin, 2000).
- Badminton (Abernethy, 1988).
- Football (Onwuegbuzie, 2000).
- Hockey (Starkes, 1987).
- Soccer (Willimas, Davids, Burwitz & Williams, 1993; McMorris & Bezealey, 1995; McMorris & Graydon, 1996).

Starkes, Weir, Singh, Hodges & Kerr, (1999) took a developmental perspective and studied the maintenance of expertise with age. The information derived from these studies has begun to clarify our understanding of expertise in general, as well as expertise within specific sports. We are just beginning to understand, for example, the relationship between the acquisition of motor skills and knowledge about a sport, what teaching and coaching methods can be employed to help novices to become expert players, and how abilities, skills and knowledge interact at various levels of expertise.

Research about performance in open skills have identified the following abilities as possible sources of expertise in performance:

- The coding, decoding and ability to group information into meaningful "chunks".
- The speed and accuracy of information retrieval from the long-term and short-term memories regarding structured and relevant game situations.
- The use of early visual cues leading to unhurried but timely decision-making.
- The effective use of anticipation.
- The efficient organisation of visual search patterns.

These functional abilities may help explain the nature of expertise in highly strategic sports. Experts use relevant information to their advantage. They can accommodate large amounts of task-specific information within a short time and systematically process and interpret that information to arrive at detailed meaningful patterns for use (Allard & Burnett, 1985; Goulet, Bard & Fleury 1989; Garland & Barry, 1990; Abernethy, 1991; Garland & Barry, 1991; French & McPherson, 1999).

Current Approaches to the Study of Expertise in Sport

The limitations of the initial efforts to study expertise in sport have been well documented by Abernethy, Thomas & Thomas (1993) and Abernethy, Burgess-Limerick & Parks (1994). The use of longitudinal research designs is now recommended because some of the characteristics expert performance may emerge within a short time while others may take longer to develop. The notion that it takes ±10 years to become an expert

in sport has been rejected as too simplistic, however only by using longitudinal research designs can possible sequences and rates in the development of expertise in various sports be discovered. A study on the development of expertise by Bloom (in Abernethy et al. 1993) and another study by Bush and Salmela (1995) are good examples of longitudinal research designs.

Another paradigm shift to influence future research about sport expertise is the emphasis on ecological validity, which means that the research should be conducted in the real world of practising sport – or at least as close to the "real thing" as possible. Information from this kind of study is derived from actual game situations. Examples of this approach include:

- Ripoll and Benguigui (1999) – The emergence of expertise in ball sports.
- Vernacchia et al. (2000) – The psychosocial characteristics of Olympic track and field athletes.
- Mcpherson, (1993) -Knowledge representation and decision–making in sport.
- French et al. (1995) - Expert-novice differences in cognitive and skill execution components of baseball performance.
- McPherson & French (1991) –Changes in cognitive strategies and motor skills in tennis.

Abernethy et al. (1993) also suggested that laboratory studies be complemented by field studies and vice versa so as to verify the validity of any research findings. This position recognises that sport expertise is a context-sensitive phenomenon. Accommodation of the contextual nature of sport expertise has been provided by Bush and Salmela (1996), who have recommended that research on sport expertise should create opportunities for interaction between the researcher (s) and the sport performers (the informants) in their natural sport environment. The information that is gained out of this environment is proposed to be more sensitive to determining what the athlete is experiencing and therefore can provide a shared subjective understanding of nature of expertise. The authors noted that the discovery of a "shared understanding" between researcher and athlete is an appropriate research outcome, since many athletes do not seen to understand what makes them an expert in their particular sport.

Still another recommendation to raise the standard of research about sport expertise was made by Thomas and Thomas (1994). They suggested the analysis of multiple

measures of *skill, knowledge and game performance* as three important variables for understanding expertise in sports. They argued that measurable motor expertise (skilfulness in performance) must be central to the study of expertise in sport because it is through the athletic movement that expertise is manifested. Note that expertise in sport is not interchangeable with expertise about sport, which could be associated with cognitive knowledge only. Based on empirical studies of the athletes in their natural environment, criteria for the identification of the expert performer and measurements of levels of expertise could be established that could help identify experts in a given sport.

Based on current literature, the processes and factors that affect the development of expertise in sport is summarised in Figure 1.

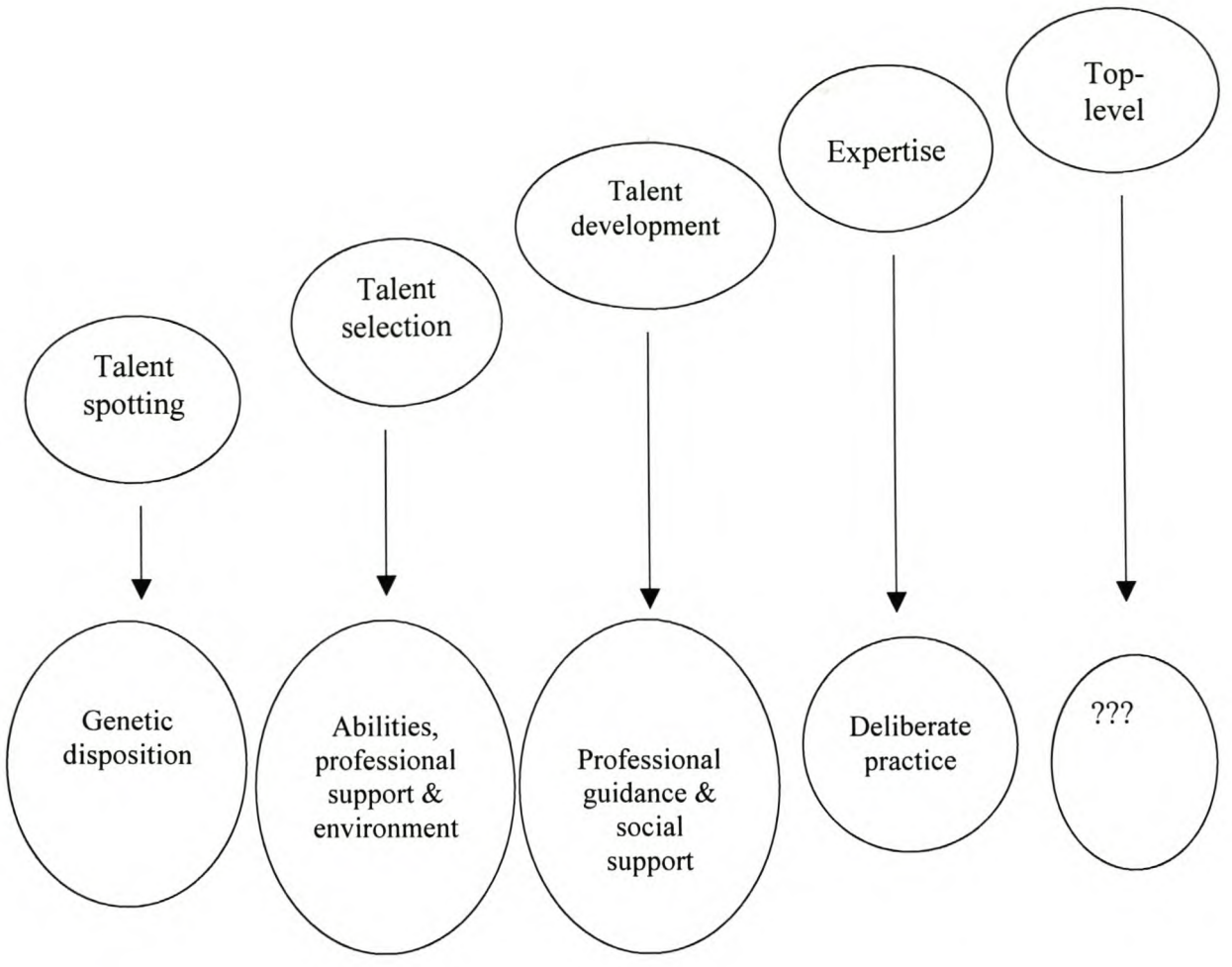

Figure 1.

Issues Relevant in the Development of Expertise in Sport

Based on what is represented in Figure 1, it can be seen that the development from novice level toward sport expertise can be conceived as a complex and interrelated process. Input ranges from the individual athlete to the parents, teachers, coaches and the environment created by the sport itself. This list may not be exhaustive but it does provide the main elements that seem to dominate athletic development. At each stage of athletic development, a correct balance among contributing variables is important. In some way, the preparation of an athlete may be related to the processing for goods in a factory. If the raw material for the production of the required material is not available in the required amount, the manufacturing process may not take place. If the raw material is available but the process is not adequately followed as per specification for the treatment of the raw material, then the final product will not meet the required standards and may not be taken

to the market for sale. On the other hand, a quality product will be produced if the right material is available and all the treatment processes are observed during the preparatory process.

If we continue with this line of reasoning, the level of expertise will be the product of the quality of the treatment processes given through the different stages of the development. The basketball player in the club is said to be an "expert club player" once he/she has been exposed to the proper training and support throughout the several years of practising and competing. In other words, apparent level of expertise will vary according to the level of competition. Based on this conception, the level of expertise of the athletes at the highest levels of competition earns them the special designation of "top-level" performers. Top-level athletes exist in every sport. However, little is known about the specific qualities that characterise the achievement of expertise at the top-level.

Contemporary research has addressed the macro-level of sport expertise, i.e. the different processes that may be involved in talent identification, development and acquisition of performance expertise in both general and specific sports. Specifically, studies the development of the knowledge base (French & Thomas, 1987, McPherson & French, 1999) as well as on levels of performance skill (French, Spargeon & Nevett, 1995; McPherson, 1999;) have been reported. These studies, however, have not addressed what happens at the pinnacle of sporting excellence. Intuitively, coaches know that there is something special about this top-level of performance. The criteria for the selection of basketball players for the national team and professional leagues, for example, often are based on the consistency and quality of athletic performance over two to three seasons, rather than performance in a few games. Although it is known that their performance is better than the rest in their age group or and league, what exactly make them top-level players has not been documented by previous studies. They are the "best of the best," and are often described simply as elite level players.

Significance of this Study

According to Abernethy et al. (1993), Starkes and Allard (1993) and Abernethy et al. (1994), there are several reasons why the study of sport expertise is important, including:

1. The increased demand for talent identification, selection and the development of top-level sport.
2. The search for innovative teaching and coaching methods to accelerate the development of talent.
3. The need to expand our understanding of how expertise is developed in order to provide insight into learning and achievement at all levels of sporting performance.

Talent development is a highly complex process. Bloom (1985) noted that the development of a novice player to an expert athlete is a process that takes an extended period of time and that the individual will pass through different stages of learning challenges. The opportunity to become an expert athlete begins with choosing the right sport. In their early years, many young people have an interest in a variety of sports. As they gain experience, they may focus their efforts in one sport. This choice may be made because their peer members are playing the sport, and because it is full of fun and performance rewards. The choice may be made because it is a sport that their parents enjoy playing. However, if the highest levels of performance are to be achieved, it is also important to base the choice on the individual's physical qualities, intellectual and personal characteristics in relation to the chosen sport.

The importance of making a good choice is apparent when one considers that deciding to pursue top-level achievement means mobilisation of extra resources to support the development of the child. Parents may engage an expert coach to take their child to another higher level of athletic achievement at school; the child may receive special attention by the teachers and recognition from his/her peer group. There are also no guarantees in the process of talent development. The process is long and full of stages. According to Bloom (1985), some development snags may take place as the child makes a transition from one stage of development to a higher one. Changes of teachers and coaches

may affect the individual development of the young athlete. Other factors that can shape development include injuries, competitive stress, change of interest among peer group members, too intense training loads and insufficient time to rest, as well as the reliability of a balanced diet.

Knowledge of sport expertise has its implications for both the theoretical and practical applications that are significantly important to the researchers and the teachers/coaches in the schools and clubs respectively. For example, the progressive development of expertise is dependent upon our understanding of the respective roles of declarative, procedural and strategic knowledge in the organisation of the knowledge at different levels of expertise. Similarly, an understanding of how and when to introduce which kind of knowledge will provide the key to understanding when and how to use the medium of computer simulations of different sport movements and tactics to enhance real-world performance.

The Purpose of this Study

The purpose of this study was to identify the perceptual motor characteristics that characterise top-level basketball players. Sport presents a unique perspective on the study of human expertise. The interaction of knowledge structures and perceptual motor skills during rigorous game situations presents a unique ecological context that cannot be experienced in other areas of human expertise like music, surgery, creative writing, typing and so on (Thomas & Thomas, 1994). Part of the uniqueness of the context is brought about by the extraordinary time constraints required in order to make decisions and produce quality movements. The term movement quality in this study refers to a movement that is performed at the correct time and that produces the desired result. In sports such as basketball, the environment changes every fraction of a second. Both the players and the ball are in constant motion and in directions that can be difficult to predict. A basketball player away from the ball moves in time to rebound before he/she knows whether or not the shot will be missed. A ball handler does not always know if he is going to shoot or pass the ball in the next fraction of the second. It all depends on the situation given by the opponents and support from team-mates. Deciding correctly and moving with quality is the essence of top-level performance and when an individual can perform at this level with consistency, he/she can be considered an expert.

As suggested by previous studies on expertise (Abernethy et al.1994; Thomas & Thomas, 1994;), the understanding of expertise in sport should be derived from the motor components of performance. Expertise at the top-level is demonstrated by the flair and accuracy of motor performance. These are products of the perceptual motor system. Physical fitness at the top-level should not be a discriminating factor between the very good players and the truly " top-level " performers, since fitness levels should be at an optimal level for both. Genetic factors and anthropometric variables may influence whether a player makes it to a high level of competition in basketball or not, but there is no research to indicate that these factors discriminate between the very good and the top-level player. This study therefore is aimed at describing the kind of perceptual motor performance qualities that support the successful performance of basketball players at the elite level.

The study also had two general objectives. This study should enhance our knowledge of the perceptual-motor processes that characterise top-level performance. The knowledge gained from the study of expertise in basketball should be applicable to identifying methods of coaching basketball to help players achieve top-level performance.

Research Questions

This study was guided by the following research questions, each of which served as a focus point for collecting, analysing and interpreting data about the perceptual-motor characteristics of top-level performance:

1. Are their any aspects of the process of perception that characterise top-level basketball players according to expert coaches?
2. Are there any aspects of the decision-making process that characterise top-level basketball players according to expert coaches?
3. Are there any aspects of motor performance that characterise top-level basketball players according to expert coaches?

Methodology

Within the scope of this study, only a qualitative method of inquiry was used: the long interview. This decision was made because the "environment of basketball" experienced at the top-level of performance is unique. It is assumed that play at the most elite level is extraordinarily difficult to quantify because what distinguishes these players may be subtle and even specific to the individual. The possibility to achieve statistically significant differences between levels at this extreme end of the continuum of expertise did not seem likely. This may be why previous studies on expertise have been limited to explaining the basics of the acquisition of expertise in a sport. Marshall and Rossman (1999) provided support for using a qualitative methodology in their description of what this approach can offer:

- The ability to identify and describe the complexity of the movement patterns involved in the natural game situations.
- The power to determine inconsistencies and conflicts attached to the performance situations.
- The capacity to help explain how the tactics and strategies of the game may vary at different levels of basketball competitions.

Although the analysis of qualitative data is open to interpretation from different sources, the method has an interactive character. It is believed that through an interaction between the researcher and the informants in this study, unique insights into the nature of the characteristics of top-level expertise will be discovered.

Limitations

Two limitations must be kept in mind when reading this study. First, it was decided to search only for the perceptual-motor characteristics of top-level performers in one specific sport: basketball. The second limitation was related to the method of inquiry. The primary tool for data collection in this study was the interview. Although measures were taken to create a productive atmosphere while conducting verbal interviews with the coaches, the different levels of their understanding and experiences of the game may not have been fully exploited. These experts had been coaching basketball for many years and therefore they had extensive knowledge and experiences about the game. Although the interview was designed to elicit their views, informants ultimately decided what information to give and what to omit.

Definitions

The following key terms were defined operationally in order to provide a basis of understanding expertise in basketball.

Performance quality

At the elite level of athletic performance, it is a proficient display of athletic performance that emphasises successful adaptations to changing game environments leading to the achievement of the desired goal.

Expertise

The concept of expertise in sport is based on a theoretical rather than an application point of view. It is the ability to meet challenges successfully – efficiently and effectively. This leaves the concept open to developmental interpretations, such as "an expert junior tennis player" or "an expert professional tennis player" (Abernethy et al. 1993; Thomas, 1994; Starkes et al. 1999).

Top-level or elite player

According to the current study, a top-level athlete is an expert among other expert players.

Summary

Understanding what it takes to perform at the top-level in basketball is a necessary step in determining how top-level performance can be acquired and sustained over many years. It is a critical insight for both coaches and players, who invest many seasons of practising and competition in order to approach sporting excellence. Although there is considerable research activity surrounding the progress from novice to advanced level performance in a variety of different sports, there is a dearth of literature on what characterises the truly top-level performer. This study provides insight into this specialised aspect of expertise, specifically in the game of basketball.

Chapter Two

Expertise in Sport

Knowledge about the development of expertise in sport is important for researchers, teachers, and coaches. For example, understanding how declarative, procedural and strategic knowledge is learned and integrated has a role in the enhancement of performance at different levels of expertise in different sports. The dynamic interaction of these knowledge structures and motor skills during game situations presents a unique opportunity to study the phenomenon of expertise in a context that cannot be experienced in other areas of human expertise, like music, surgery, creative writing, etc. (Thomas & Thomas, 1994).

The unique difference of the sporting context is brought about by the time constraints within which an individual is required to make a decision and produce a quality movement. The term movement quality in this study refers to the selected movement that is timely executed for the emergent task. In high strategy sports, like basketball, the rapid environmental changes are unpredictable, which increases the complexity of executing the required movements. Because both the players and the ball are in constant motion (and sometimes in different directions) the environment is not fully predictable. The possibility that a particular basketball player who is away from the ball, will move in time to rebound the missed shot, requires the integration of correct decision-making with precision of motor skill performance. The ball handler does not always know if he/she is going to shoot or pass the ball in the next fraction of the second. It all depends on the situation of the opponent and the teammate players.

Top-level players are recognized as "experts of the experts." Their performance is on a level above the rest of their team and age group colleagues. The immediate question that comes in ones mind is, "What is it that make these players produce accurate decisions and effective motor skills - with or without the ball – at just the right time and place?"

The Study of Expertise in Sport

The formal study of expertise in sports and games started in the late 20th century. De Groot (in Chase & Simon, 1973) studied perception (thoughts and choices) of master chess players to find out the structure of their memory. This marked the beginning of studies on expertise in sport performance. As a follow-up study, Chase & Simon (1973) compared the memory structures of master chess players and novices. They concluded that players develop a hierarchical organization of the chunked information following a short exposure to the different game situations. The organization of memory structures of the master chess players was found to be more efficient.

Traditional Approaches

Since the early studies of chess players, expertise in sport performance has been studied from different domains using different methodological approaches. Knowledge about sport expertise has been studied from a cognitive psychology perspective in relation to a variety of components of performance, for example:

- Abilities and skills in basketball (Starkes Allard, Lindley & Reilly, 1994).
- Knowledge representation in tennis (McPherson, 1991).
- Psychosocial characteristics of Olympic track and field athletes (Vernacchia et al. 2000).
- Perceptual strategies in badminton (Abernethy & Wollstein 1989).
- Aging and retention of expertise (Starkes et. Al, 1999).

The reports produced from these studies have contributed to the understanding of expertise within the context of specific sports. This includes:

- How motor skills and knowledge about the game are acquired.
- How teaching and coaching methods can be adapted to accelerate the development of the novices to become expert players.

- How knowledge about limitations of abilities in the acquisition of skills can be addressed.

Although the results of some studies have been generalized in order to identify generic component structures for the acquisition of sport expertise (Ericsson, 2001, Ericsson & Charness, 1994), the current research trend seems to indicate that sport expertise is based more on specific sport domains more than generalized developmental trends. For example, the cues required for tracking the ball in volleyball are different from those required in the game of basketball (Starkes & Allard, 1983).

The two different approaches in the study of sport expertise has been identified in Abernethy's (1994) critics on contrasting studies in sport expertise as one of the limitations for the development of knowledge. Importing theories from the cognitive psychology to explain the nature of expertise in sport, for example, does not account for the unique environment surrounding. Within this approach, the superior performance of any athlete is dependent on the level of attunement to environmental changes.

The Paradigm Shift

The paradigm shift that is now emerging in the field of research is indeed an evidence of the contributing effect of the ongoing studies on sport expertise. As far as the methodological aspect for the studies is concerned, there is growing emphasis for research works to be conducted as much as possible in the "real world" of sport. Studies within practical sporting contexts include:

- Ripoll and Benguigui (1999). Emergence of expertise on ball sports.
- Vernacchia et al. (2000). Psychosocial characteristics of Olympic track and field athletes.
- McPherson (1993), French et al. (1995). Expert-novice differences in cognitive and skill execution components of baseball performance.
- McPherson and French (1991). Changes in cognitive strategies and motor skill in tennis.

Within the context of focused research in sport, different researchers have emphasized different components of expertise. Some authors have looked at expertise as a product of the motor component of performance (Abernethy et al. 1994; Thomas & Thomas1994). The identification of motor expertise as the focus reflects the belief that expertise is found in the athletic movements and not in expert knowledge structures or expert perceptual qualities. Within this point of view, expertise is characterized by the flair and accuracy of the demonstrated movements. Other authors have emphasized the development of perceptual processes and decision-making processes to be related to sports expertise (Williams, 2000; Allard, Graham & Parsalu, 1980; Allard, 1982).

A second feature of the paradigm shift is its flexibility in accommodating both cross-sectional and longitudinal studies on motor expertise in the different sport domains. Although most authors have used cross-sectional designs, longitudinal designs are highly recommended when studying the development of expertise. Although the "ten-year rule" (for the development of sport expertise) has been challenged, the generalization is based on a long-term perspective on tracking the development of expertise (Bloom, 1985).

Based on individual differences in learning and performance, a combination of cross-sectional and longitudinal studies would be more meaningful in the sense that some of the characteristics for the development of expertise may emerge within a short time while others may take longer to develop. Abernethy & Wollstein (1989) mentions perceptual skills as one of the components of performance that takes long to develop. From this perspective, combination approach would be relevant in the early and middle stages of the identification and selection of the talent for specific sports (Bloom, 1985). The initial motivation of the child to get physically involved in learning the sport is crucial. This phase is immediately followed by the motor skill-learning phase. At this point, anthropometric measurements and the identification of specific abilities can be made that will help identify the sport types in which talent development is most probable (Hoare, 2000). These findings have relevance due to the fact that the information that has been reported originates from the actual game environment (Abernethy et al. 1993).

A study on the development of expertise by Bloom (1985) has been most cited as a classic example of longitudinal research design. The study commenced with 120 youths who participated in swimming, tennis, piano and mathematics. Of this number, only 10% managed to acquire expertise within their activity domains. The remaining youths

developed to different stages due to a variety of individual characteristics. Bloom (1985) noted that the development of a novice to an expert athlete is a process that takes time and associated with different stages of learning challenges. He suggested that at least ten years of commitment and hard work was the minimum duration for the emergence of expertise in a specific sport.

The paradigm shift has found direction in three complementary approaches to the study of expertise in sport:

- Inter-disciplinary approaches that identify (1) the differences between expert athletes and novices on selected variables of sport performance (Thomas & Thomas 1993) and (2) abilities as possible determinants of acquisition of expertise (Kioumourtzoglou et al. (1998a; 1998b); Kioumourtzoglou, Michalopoulou, Tzetzis & Kourtessis, 2000.).

- Multiple measures that focus on underlying knowledge structures as well as the perceptual and motor skills of experts. Thomas & Thomas (1994) suggested use of multiple measures of skill, knowledge and game performance as important variables for understanding expertise in sports. Based on empirical studies of the athletes in their natural environment, they proposed that criteria for the identification of the levels of expertise could be established.

- Constructivist approaches based on the pedagogical concepts of "negotiating" acquisition of knowledge from the environment (Bush & Salmela, 1996). Within this approach, interactive opportunities are created between athletes and researchers. The information gained from this environment reflects athletes' understanding of their own experiences in developing expertise.

The Development of Expertise: An Overview

The development of expertise in sport has been conceived by the author of this study as a complex process with at least four different phases: early development, middle development, expertise acquired, and top-level (see Figure 2). The chance to become an expert athlete begins with choosing the right sport. During early development, children have diffused interest in sport. They would like to experience several sports that they come across at school and club. As they gain experience, they move to middle development, where they focus their interest in one sport. Often the sport they choose is a sport that their peers are playing and that is full of fun and performance rewards. Sometimes children get interested in a sport that either their parents enjoy playing or that their parents encourage them to play. Quick performance improvements are common during the early stages of learning and feelings of competence may be one of the motives that may keep children focused on one sport.

There is definitely an advantage for those youths who possess the physical, intellectual and personal characteristics that are well suited to the demands of their chosen sport. Future success also depends on individual effort and support given by parents, teachers and the community (facilities). Parents and teachers may be able to think of ways to help the child achieve more in the sport. The parents may engage an expert coach to take their child to another higher level of athletic achievement. This means mobilization of extra resources and financial support for the development of their child.

The views originating from Bloom's (1985) model as well Hoare's (2000) on identification of talents in Australia are supported by those from the advances on traditional approaches and the paradigm shift.

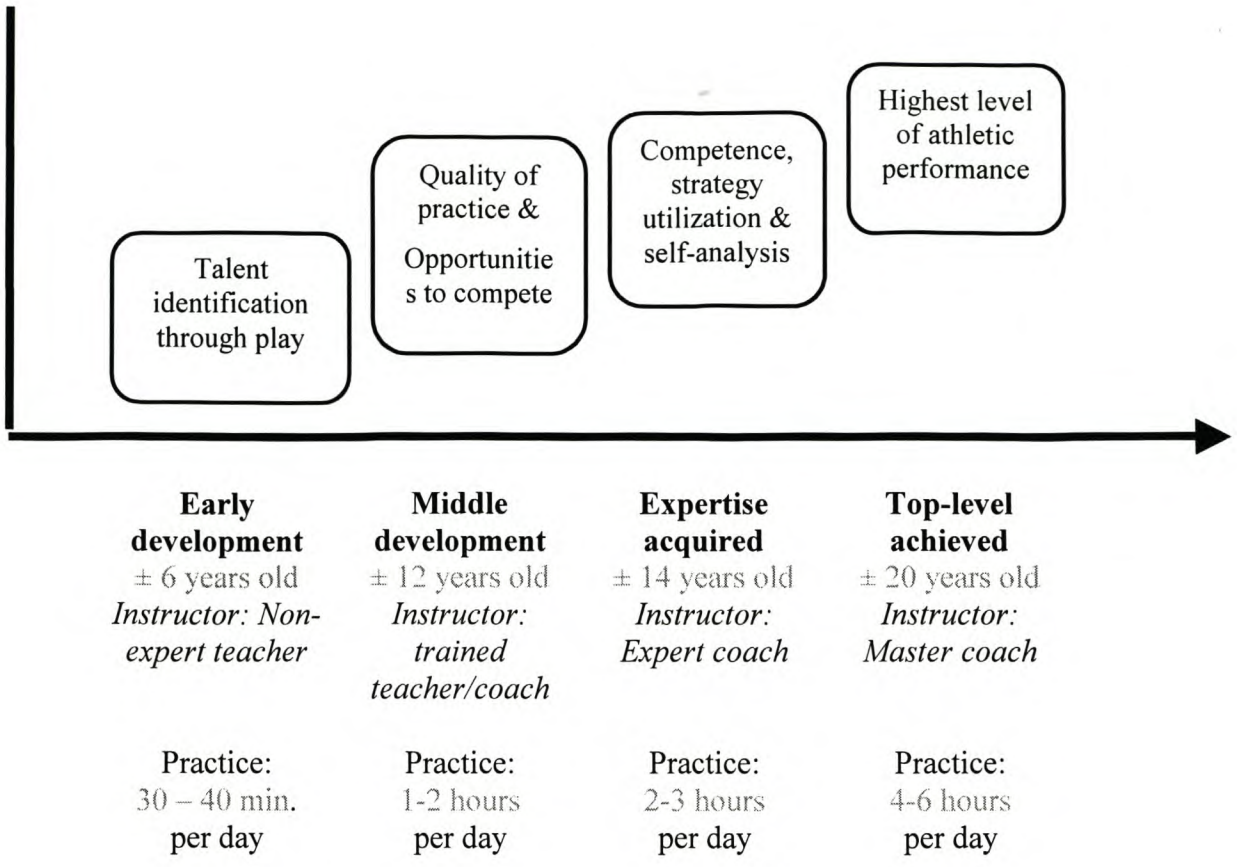

Figure 2.

A conceptualisation of the processes involved in the development of expertise in high strategy sports

According to Bloom (1985), some development snags may take place as the athlete makes a transition from one stage of development to the higher one. Changes of teachers and coaches may affect the individual development of the young athlete, and if the expertise of the coaches is below the level of the child, that may limit the child's opportunity in reaching the desired athletic levels. Other factors including injuries, difficulty dealing with competitive stress, changing interests of peer group, too heavy a training load and too short a time to rest, unreliable and imbalanced diet must be considered as impediments. However, the accumulated number of hours from age 6-20 years should contribute toward the quality and level of expert development (van Rossum, 2000).

Expertise and Top-level Performance

An overview of research about the development of expertise in sport has had impact on the search for a model or structure for thinking about what it takes to become a top-level expert performer. The different ideas that have emerged from the research have focused on perception, cognitive processes and motor skill (Starkes & Allard, 1993; Thomas & Thomas, 1994; Singer & Janelle, 1999; French & Nervett, 1993) as underlying qualities. It must be acknowledged that the acquisition of expertise in sports has many different features and with different contributing factors. Although the journey to becoming an expert performer has been reported to be influenced by multiple processes (Singer &Janelle, 1999, Starkes & Allard, 1993), exactly how these processes take place is not clear.

It can be argued that the development of expertise is influenced by individual as well as social and economic factors (Davidson & Templin, 1986). It is unlikely that any of these factors can operate in isolation, but rather interact in combination with other factors. Figure 3 presents a conceptual model pulled together by the author of this study as a context for this research. It acknowledges that, although this study is focused on determining the perceptual-motor characteristics of top-level players, there are other critical dimensions to consider in the acquisition of sport expertise.

It is obvious from this model that not all novices will be able to reach the pinnacle of performance expertise. The pathway to becoming an expert requires strategic planning and considerable input of resources ranging from the individual athletic capabilities to support from parents, teachers and coaches. A combination of these factors with the training programs will improve the athlete's development.

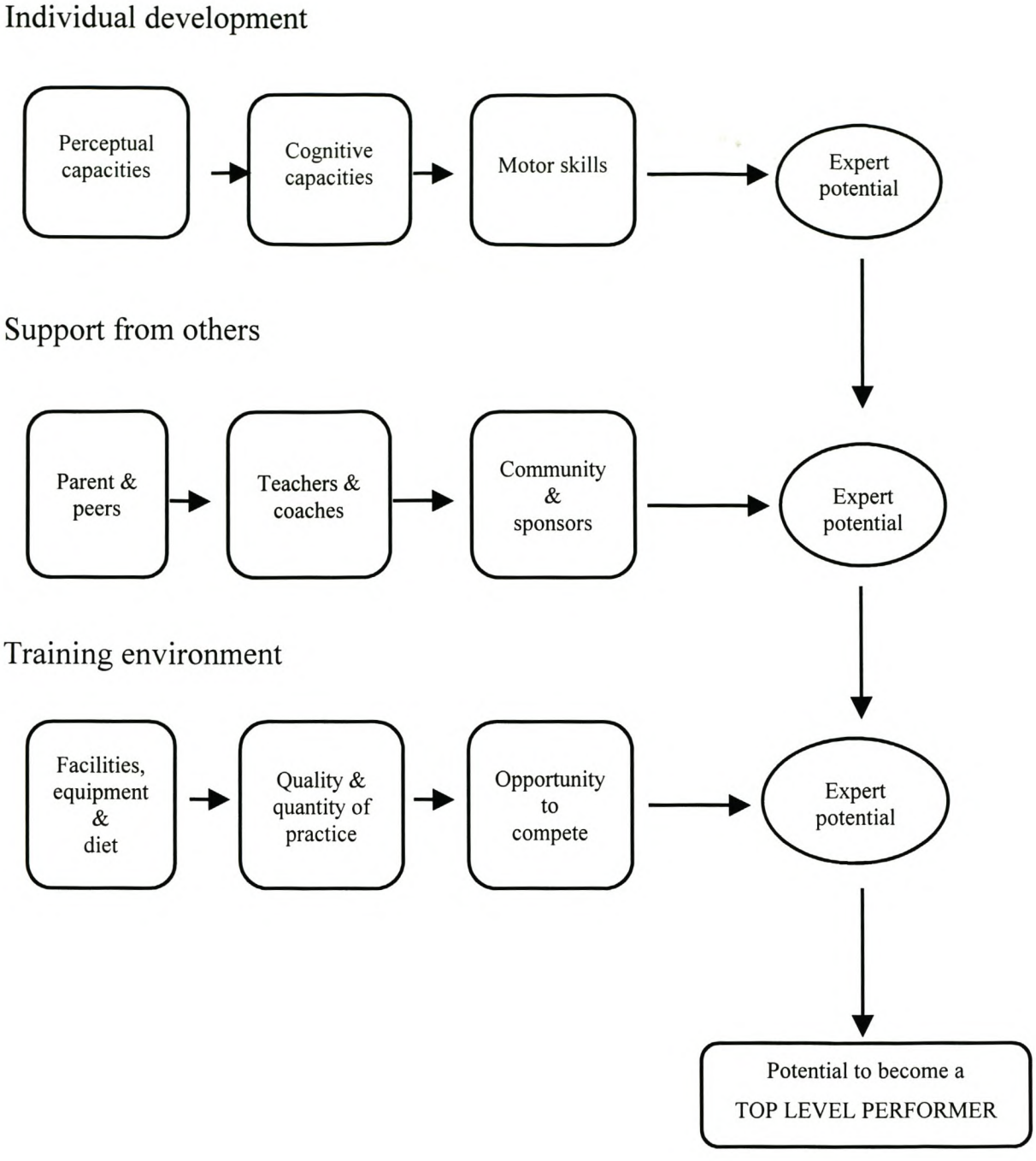

Figure 3.

The risk approach to the top-level performance

Summary

Although this study will focus on identifying the characteristics of top-level experts from the perceptual-motor point of view, the process of development is regarded as a complex one that involves many other variables. Based on what has been reported from the literature reviews, it appears that research methodology is one of the problems that have limited the development of a comprehensive understanding about sport expertise. Decisions about the methodology to use are difficult when the focus is on gaining an understanding how expertise is manifested within the natural game environment.

Chapter Three

Perception and Sport

Bartley (1981) defined perception as the immediate response of the individual to stimulus (impingement) inputs to the sense organs. This impingement either may be proprioceptive or exteroceptive, depending on the source of the information. The sense organs would relay the relevant information to the higher levels of Central Nervous System (CNS) for encoding. However, not all inputs would be encoded in the CNS. It is only specific signals with certain amount of magnitude to create sufficient amounts of impingement at a given threshold that will cause activation of the memory programme for information translation.

In reference to most "open sports", like team ball games and racket sports, much of the perceptual information is exteroceptive in nature. In this study, the term "open sports" is used to refer to the kind of sports where external sources of information are critical to performance and where information must be gathered from the consistently changing environmental tasks. This review will focus specifically on the system of visual perception because it provides most of the external originating. Therefore, visual perception has been a focus for research about expert-novice differences in sport (Coffey & Reichow, 1995; Loran & MacEwen 1995).

In open sport environments, two sources of visual information are important. Firstly, the player must learn to see and interpret different surfaces and shapes of objects that are either stationery or in motion. The term object in this case refers to the other players and the ball and all of the interactions among them. The disposition of these objects affects players during the performance of a variety of tasks. The quick movements of the arms and legs can be seen in basketball during running movements, with or without the ball. The subtle co-ordination and/or synergetic movements of an opponent create a pattern that the player must learn to read before adapting to it. There are even more complicated athletic movements that require co-ordinating two objects during performance in a given direction at a certain speed. For example dribbling while running and finish it with a pass or shot attempt.

Visual acuity has been identified as one of the fundamental visual skills that allow the player to see the surfaces of objects (Loran, 1995). The player uses visual acuity to help in discriminating who are team-mates from opponents, to help judge the speed of the ball and the distance to the passer, receiver and so on. In a study of computational approach to visual recognition of arm movements, Vaina and Bennour (1985) emphasised the importance of the surface shape of the object in improving communication for the quality of performance. Through visual acuity, one can see the type of arm that is extended to either side for immediate response.

Secondly, skilful players in high strategy ball games move to create open spaces away from the ball. In basketball, players are striving to use to the maximum court space available. Sometimes one can here them reminding each other to be "floor wise". The basic movement is to step in an uncovered space, look for a ball and either shoot or pass to someone with a high shooting percentage. Many scoring opportunities are generated from off –ball movements of the team mates. To be able to communicate effectively in these situations, vision is important. It is not clear which visual skill dominates this "reading of open spaces," but the importance of visual perception is clear.

Vision and Sport Performance

Vision has been defined by Loran (1995) as the opportunity to discriminate the differences in the external world in terms of form, colour, position, size as a result of the different stimuli reflected by objects in the environment and received in the retina. Vision is one of the critical parameters influencing human performance and in the last decade it has been established as a science in its own right. Vision is the ability to gain meaning from what our eyes can see from the environment. In sport, vision provides knowledge of what is happening and it triggers the decision-making process. Although full vision may not be a requirement in some sports like running and swimming, a visual impairment in a sport like basketball would limit opportunities for success.

There are different ways of explaining how visual information is generated and used. From a physiological perspective, there are neuro-pathways that link the eye and the cortex. The two eyes have different parallel pathways that are connected to the primary visual cortex and other areas for accessing meaning from the kind of stimulus input in the

retina area. The stimulus from the retina is channelled along the two major pathways. The interpreted meaning of the information is co-ordinated with input from the other sensory - perceptual abilities. The brain performs the inter-sensory matching function before the cognitive part of the decision –making and the motor response are put into effect (Gardner & Sherman, 1995). Feedback is utilised during all these processes to correct and refine the movement sequences.

Singer, Williams, Frehlich, Janelle, Radlo, Barba & Bouchard (1998), identified the ability to efficiently process information from the environment as one of the critical skills of expert sport performers. Research has been directed toward understanding which specific visual processing mechanisms may be dominant among expert players as opposed to the lesser skilled and novice players. There is evidence that expert players have acquired specific visual skills and strategies as a result of training for improved performance in their sports (Starkes et al., 1994; Williams& Grant, 1999). However, these functional qualities cannot be generalised to all sports because different sports require different visual skills. Williams, Davids, Burwitz & Williams, (1992) reported the ability to efficiently process information from the environment as one of the critical skills of expert sport performers. Research has been directed toward understanding which specific visual processing mechanisms may be dominant among expert players as opposed to the lesser skilled and novice players.

Speed of Processing Visual Information

Gardner & Sherman (1995) identified the speed of processing visual information as one feature that distinguished between winners and losers in a competition. Of course, this would depend on what kind of sport is under investigation. In some sports like basketball, not only is the speed of visual processing important, but optimal visual speed (timing) is needed to facilitate performance of complicated movements with flair. The process by which a basketball player manipulates the ball through complex dribbling skills and finishes with a lay-up or jump shot requires speed in information processing as wells as optimal speed of eye movements. However, high speed may be the cause of many errors and in basketball, such as turnovers that can significantly affect the team performance. Certainly, the top players seem to have the capability to process information

at high speeds so as to facilitate the speed of inter-sensory matching and integration of the necessary information before the decision-making and response actions (Loran, 1995).

Visual Search Skills

Studies in visual search strategies show that expert players have superior visual skills and also are able to select relevant information required for a specific task within a shorter time than novices (Allard et al. 1980; Davids, Palmer & Savelsbergh, 1989; Barfield & Fischman, 1990). The quality and range of movements experienced in open sport situations is to a great extent influenced by visual perception. The type, kind, flair, speed and direction of the movements experienced in basketball game situations are dependent of the ability to integrate relevant visual information (Singer et.al (1998).

Williams, Davids, Burwitz & Williams (1994) completed a study on visual search strategies among experienced and inexperienced soccer players. The aim was to understand the extent to which visual skills could contribute in anticipating ball passes during structured soccer games. Fifteen subjects in each of the experienced and non-experienced groups viewed structured game videos on a 3m square screen projector from a distance of 3m away. Their task was to respond verbally to the player number that was related to the box number in the experiment who received the ball immediately a pass was completed. A BBC microcomputer timer recorded the reaction time interval from movement initiation to the onset of response. Results indicated that experienced soccer players were superior in anticipation than their counter group subjects (non-experienced). Experienced players demonstrated effective eye saccadic movements between the ball handler and the peripheral players in relation to the different spaces. Inexperienced players fixated on the ball area most of the time. To the expert soccer players, the quick fixations of shorter duration around the ball area in relation to the surrounding are considered as determinant factor of the reaction time for appropriate anticipation of the ball and the player movements. The high accuracy in anticipation is therefore reflective of the expert ability in using early visual cues related to opponents' movements with or without the ball to enhance the speed and accuracy of decision-making.

Based on experiences gained from studies in visual perceptual skills, the acquired high adaptation levels of visual search patterns for accessing specific information from the field have identified the visual strategies of expert performers. Their visual searches are

quick and selective in recognizing the specific areas potential for viewing. While novices fixate their eyes on the ball handler most of their time, experts' visual awareness covers a wide area including the teammates, opponents, open spaces on the court and even the referees. When a pass is made, they do not track the ball flight, but rather predict where the ball is going so they can try to get there in time to catch it. This difference between experts and novices has been documented in soccer (Helsen & Pauwels, 1993; Williams, Davids, Burwitz & Williams, 1993; McMorris & Beazeley, 1997; Ripoll & Benguigui, 1999). The expert player has the ability to determine the kind and quality of visual information from the field that is applicable in an event.

Peripheral Vision

Peripheral vision, or central peripheral awareness, is often mentioned in terms of expert sport performance. Peripheral vision refers to a player's ability to gain information from outside his/her focal vision, i.e. from a wide area of the playing field (Fradna et al. 1995). Peripheral vision is critical in open team sports where there is so much uncertainty about the actions of the other players and the ball in relation to the spaces. If one can imagine the kind of movements required in soccer, volleyball, field hockey, rugby, handball and basketball, then it becomes easy to understand the importance of peripheral vision in these sports. In a study of the effects of fatigue on peripheral vision, O'Connor and Crowe (1999) found that with extreme fatigue, peripheral vision of elite league rugby player gets narrowed. They recommended that peripheral vision training should be included in the daily practice session of elite players.

Visual Anticipation

Expert players also have developed specific visual anticipation skills acquired from their specific sports. Jones and Miles (1978) compared the prediction ability of 32 professional tennis coaches to the lesser skilled tennis players and novices in relation to receiving the serve. Subjects had to predict the landing position of the ball based on looking at initial movements of the legs, arms, racket and the ball during a serve. Professional coaches were significantly more accurate in predicting the next landing position of the ball than either lesser skilled or novice players.

The ability to predict the next alternative movement of the player, the ball or both is critical in strategic sports that are dominated by a lot of uncertainties. In a study of training methods to improve anticipation in selected sports, Abernethy & Wollstein (1989) emphasised the importance of anticipation in relation to the high speed of the ball in tennis, squash and badminton, or shuttle cock in badminton. In racket sports, the defender (opponent) has to read the early signs of the opponent player while taking the serve. Based on that, he/she is able to time the ball by moving correctly. The potential sources of information in the situation include the racket, and its alignment to movement of the shoulders and waist of the player as well as the position of the player on the court before the striking action (serve the ball/shuttle). Two sources are important for increased probability of anticipation:

- The position of the opponent player on the court before the start of the serve. Standing close on the line or far away from the line will have an impact on the kind of the ball to be played. The kind of dominant stroke that is used by the player may also be one of the visual cues. Some players like eliminating sources of errors and therefore use only one serve strategy throughout. However, opponent weakness can easily be discriminated by the serving player making quick movements to the net or wall immediately after the serve stroke.

- The postural cues in the sequence of the moving arm, racquet and lower body. This sequence may be helpful in predicting the probable direction of the ball and therefore respond correctly. Skilled players have a visual advantage because they can anticipate these movements before the execution of the task, while lesser skilled players wait to see the ball and therefore come late to the ball (Aberneth & Wollstein, 1989).

Expert players seem to have a huge knowledge base for their sport. For example, they know that if the first serve of the tennis ball was too fast and went to the wrong court, the second serve will probably be a slow serve but tactically placed. It may be a low ball just above the net, a long ball aimed to hit the corner of the serving area, or a ball with topspin that will be low and difficult to play back. An expert player would be well aware of all these possibilities and remain focused on gathering early signs that will cue him/her about the correct response.

Movement Reaction Time (MRT)

Visual -motor reaction and speed of response are by product components of visual anticipation and timing. That means anticipation timing includes reaction speed, response speed and the timing of the reactions between the stimulus and motor action (Loran & MacEwen, 1995). The estimate of the hypothetical time remaining to catch a moving ball is called movement response time (Payne, 1988). As the speed of a ball increases, movement response time decreases. Payne (1988) discovered that subjects have longer response movement time available when the ball approaches them directly than they do when the ball approaches to their right or left sides. Direct approaching balls have fewer errors of response movement time. This study also reported further that coincidence-anticipation timing is one of the critical factors required in successful catching of moving balls.

Vision and Basketball

Different sports have specific visual requirements for successful performance. The most common visual skills have been categorised in terms of low, medium and high requirements for a variety of sports (Gardner & Sherman, 1995). The high demand requirements refer to visual skills that need to function at a high level if performance is to be successful. In basketball for example, lack of peripheral vision will make a player stop playing basketball. Central vision alone will not facilitate all the visual requirements for movement precision. Other visual skills critical to most sports according to Gardner & Sherman (1995) include eye-hand co-ordination, depth perception, accommodation, visual reaction time, visual adjustability and visualisation.

The visual skills rated, as medium demand is considered important due to the fact that the information gained through them will be used to support the display of information in the high demand visual skills. Although dynamic visual acuity and ocular-motor skills are required in basketball, they are categorised as medium demand skills because they provide information that supports other sources for gaining visual information. The low demand visual skills provide helpful but not essential information. In basketball these skills include static visual acuity.

In sport, visual skills are interdependent. The sight from both eyes must be co-ordinated well so as to produce a clear understanding of what that has been seen. That means the integration of the different visual skills is critical for the successful athlete. Looking at the high performance levels of basketball players in the NBA and elsewhere in the world, their achievements should have been to a great extent influenced by the gained specific visual skills.

It is critical that the expert must position himself/herself accurately in relation to the range of movements in basketball. What does this mean to the expert player? With regard to the constraints of time, uncertainty of opponent movement and team strategy, the expert player must accurately discriminate the relevant cues as soon as they are presented. Players with problems discriminating the appropriate cues, encoding relevant information for correct decision-making and executing timely responses, cannot achieve the top-level of sport expertise.

Based on this perspective, specific visual skills must be developed for searching, discriminating and selecting information for decision- making and movement production. For example, a basketball expert would respond differently to a ball that is 5m from the basket and one that is 2m from the basket. It is not only a matter of being quick to respond to the ball, but it is also a matter of deciding what to do. Vision makes a substantial contribution to an expert basketball player's ability to select appropriate responses in a timely manner. This is what could be referred to literally as the quality of the response.

Visual Memory

In the game of basketball, the ability to recall the specific positions of players on the court and their roles in the game, i.e. visual memory, is critical for expert players (Allard & Starkes, 1980; Allard, 1982; Gross, 1984). Speed of encoding game structures during high-speed basketball movements was reported to be significantly faster among expert players than among novices (Allard et al. 1980). Expert and novice players viewed two types of basketball games on videotape. Each slide was viewed for 4 seconds only. One group of slides had structured game movements of a team and the other unstructured game situations. When asked to represent the movements on a basketball field, expert players were able to recall the movement patterns of the structured games much more

quickly than the novices. Similar results were recorded from another study by Allard and Starkes (1980).

Speed of Visual Search

Significant differences in the speed of visual search patterns as well as speed of information processing in open skills have been observed among expert players (Adam & Wilberg, 1992). Think of the high speed of the players and the ball that is demonstrated by expert players during the cricket, baseball, tennis and table tennis game situations. The eyes must adapt to accommodating high-speed movement images on the retina as well as transfer such information-related cues to the CNS.

The expert player needs prior information about the location of the ball handler. Is the opponent under the basket or 3m or 5m away from the basket? What is the direction and speed of the player's movement? If the player has completed the dribble, there are only two alternatives. One may shoot the ball or pass. If it is a first touch, then the decision of what to do will be delayed until one has fully gained the early cues about the next movement. Whatever the case, a close watch should be maintained until a decision about the correct response has been reached. In each of these options, there should be different responses to counter each movement differently (Allard, 1982).

Expert players are able to view the ongoing game situation and generate appropriate responses within a fraction of a second (Abernethy, 1991). The ability of the basketball player to see, select the relevant information, reorganise and systematically select the correct response for the required situation is in part dependent upon visual perception (Allard & Starkes, 1980; Allard et al. 1980; Allard, 1982; Abernethy, 1991; Ericsson & Chase, 1994; Bard et al. 1994).

Based on the above understanding, differences in the speed of visual information processing among expert basketball players would be expected. Those with an advantage of speed in visual search skills would be capable of performing at a higher level in certain situations. Imagine the concentration of hands on the ball during scramble for a rebound under the basket. It is only the visually quick athlete who will be able to time the jump for a catch in the instant the ball rebounds off the board.

Peripheral Vision

Peripheral vision refers to the information gathered through vision about the surrounding area while the player's eyes are focused on a particular point, e.g. the ball or his/her opponent. Basketball depends on the ability to "see" these peripheral cues in order to make decisions and respond accurately. In the case of basketball, Peripheral vision is on the list of high requirements. Peripheral vision provides information that contributes to the quality of the player's movements in relation to his/her team-mates, opponents, and the ball. It has been estimated that central vision can provide information from a range about width of the thumb when the arm is fully extended forward. As far as basketball is concerned, this means that peripheral vision is essential for gaining a full view of the basketball court (Knudson & Kluka, 1997). While the central vision is fixated on the ball, the ball handler or the opponent, peripheral vision provides relevant information about the different movements that are happening around the court.

Different players in different positions will require different degrees of peripheral vision to accomplish their desired movements for specific goals. A defender against a ball handler will need information to facilitate the quick movements that may be performed by the ball handler. Since his/her eyes will be fixated on the eyes of the ball handler, the player will need peripheral vision to make decisions, but his/her peripheral vision will be reduced because of the concentration of focus. The team-mate defending the opponent who is away from the ball, will have to provide support by using peripheral vision to gain awareness of what is happening. Obviously, there will be continuous verbal communication between the two players so as to help each other. If there is a peripheral vision advantage provided by the team-mate defending the opponent away from the ball, the shared information between the two defensive team-mates will support correct decision-making for both of them.

In the case of offensive team players, their peripheral vision would be used to dominate ball possession and as a result, create scoring opportunities. Although the ball handler decides what to do with the ball, the pressure from the opponent, team members and the rules of the game is critical. In such performance situations, peripheral vision is required to provide information about how to time movements in relation to the rest of the team members and the defence. Before performing any movement, the ball handler will have to scan the different movements of his/her team members. In many game situations,

the player away from the ball should assist the ball handler. A correct interpretation of the specific movements of other players depends on the amount of vision gained at a particular time during performance. If the movement is too fast, the brain cannot create a proper image about it and therefore there will be an error of the movement production. In most cases, the player will be too late to react for the ball. The varied movements taking place away from the player on the ball, and the open spaces left unoccupied on the court creates the challenge for peripheral vision for basketball. To be "floor wise" refers to a player's ability to see the spaces left uncovered and to make decisions about using that space for either gaining possession of the ball or moving to take a shot. Expert players are quick to see free spaces based on the continuous movement of the players around the basket.

The understanding of a particular movement situation depends not only on visual information, but also on the experience of the player in similar situations. Experience can enhance the player's speed of analysing, storing, retrieving and responding accurately. The integration of the new in the old information improves the quality of movement response (Gardner & Sherman, 1995). The speed and quality at which such information is processed for response production discriminates between the expert and the lesser skilled player in a given sport. Davids (1988) emphasised the importance of peripheral vision for both expert and less skilled players because it is the visual skill that provides the best information about what is happening on the entire court. It appears that peripheral vision influences anticipation time, reaction time, eye-hand co-ordination, eye-body co-ordination and depth perception.

Visual Anticipation in Basketball

In relation to basketball, the specific cues for anticipation should be unique although the principles of anticipation remain the same. That is, emphasis remains on identifying the early signs before execution of a movement task, position of players on the court, and body alignment in relation to the ball and the basket. In basketball, anticipation cues are not based on the ball only, but also on the player on the ball and the player away from the ball. In the 3 vs. 3 basketball game, ro examle, which is popular in the court yards and schools, the use of anticipatory cues is important for containing the opponent's cutting movements to the basket. In any given game situation, one has to anticipate the

movements of the ball, the ball in relation to the ball handler and movements of the player away from the ball. Logically, the uncertainty of the off-the-ball movements contributes significantly to the successful performance of the team. These movements influence the decision-making and the quality of the ball handling.

The following examples of game situations in basketball emphasise the importance of knowledge-based anticipation for correct decision-making.

- **Passing**

  The ball can be moved while the player is standing, running or jumping. In each situation, there is a need to know the distance of the ball handler from the basket. If the ball handler is more than 4-6m away, usually a pass will be made while running in order to get the ball to the goal area quickly. If the ball handler is close to the basket, any of the three possibilities can be executed. Since the aim is to shoot, the choice of offensive movement will depend on the existing situation of the ball handler in relation to the opponent, time available and the rest of the team players. Some players will take a jump shot, while others will take a lay-up shot or even a dribble.

- **Off-ball Movements**

  Defending against movements away from the ball is difficult in the sense that there is no defined way of moving and therefore difficult to predict the possible movements of a skilled opponent. Team-mates communicate verbally or use signs. On offence, players will cut to the basket once they see that their opponent has focused on the ball handler. The defensive player tries to maintain an optimal distance of about a meter from his/her opponent in order to keeping pace with him/her. It makes it possible to adjust quickly to the consistently changing movements of expert players. In order to anticipate, visual contact is maintained. This increases the chances of seeing the early signs of possible movements and give time to react accordingly.

Visual Demands of Basketball Players

Some visual skills are strongly related to the specific roles of the different players in a basketball team. There are three distinct positions in the game of basketball:

- **Guard**

  The guard position requires one to be able to co-ordinate the movement of the ball to the rest of the players both away from and near to the basket. Players in this position must be able to feed balls to the forwards for scoring attempts.

- **Forward**

  The forward position demands one to be able to score frequently. A forward has to be able to turn and shoot quickly and accurately, as well as rebound. The player in this position functions as an immediate link between the guard and the centre in the sense that, if necessary, he/she can assume any of the roles.

- **Centre**

  The centre needs physical strength and power, as well as quick visual reaction time. The player in this position must be able to communicate effectively with all players in the rest of the positions during the game situations. He/she must be able to spot a team-mate breaking toward the basket for an open shot, as well as turn, shoot and rebound if the opportunity arises.

The visual demands of each position are dependent on the location of the player on the basketball court. The court itself can be divided in three main zones, i.e. Zones 1, Zone 2 and Zone 3 (see Figure 4).

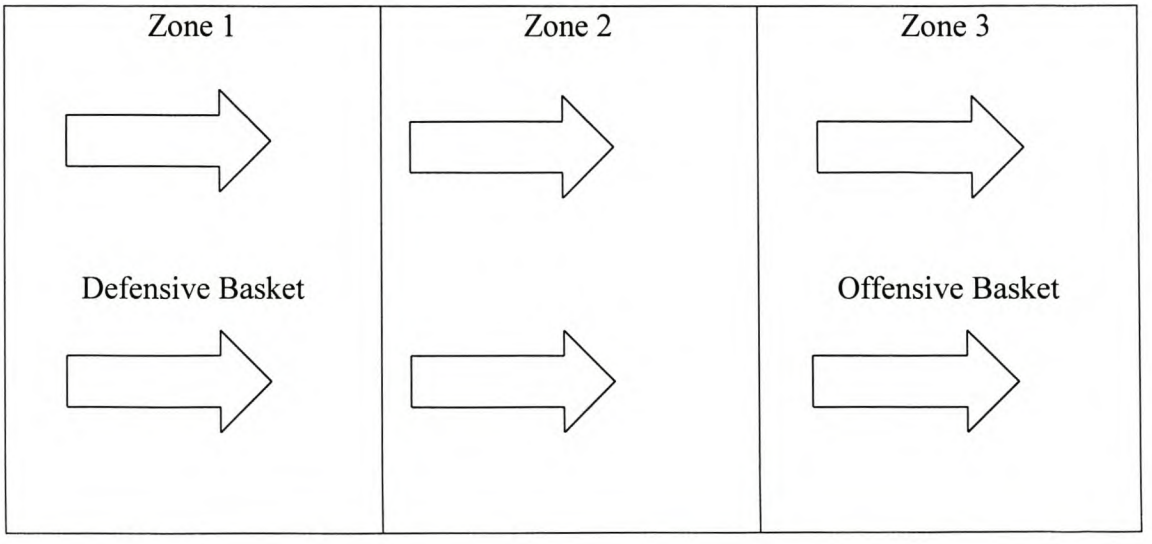

Figure 4.

Changes of visual search strategies in relation to different game roles and court positions

When the concept of Zones is combined with the responsibilities of positions, a chart can be proposed that identifies the demand for certain visual skills in basketball. Table 1 presents the author's concept of how such a chart could be formulated to identify where the higher demands for visual skills performance were in relation to players positions and where they are on court. While the validity of these categories and the ratings for each visual skill would have to be tested scientifically, the chart has been developed from what has been interpreted from the research literature on sport vision, and the experiences from different experienced basketball coaches (WWW. NBA.com website). This table is not exhaustive but does illustrate the specificity of visual skills in an open sport.

Table 1: A rating of the high-level demands on visual skills according to player position and Zone on the basketball court.

	Eye-hand co-ordination	Depth Perception	Visual Reaction Time	Eye-body co-ordination	Peripheral vision	Visualisation
Guard	Zone 1 & 3 *****	Zone 2 & 3 ****	Zone 1- 3 *****	Zone 3 *****	Zone 3 ****	Zone 3 *****
Forward	Zone 1 &3 *****	Zone 1 & 3 *****	Zone 1 & 3 *****	Zone 1 &3 *****	Zone 2 & 3 ****	Zone 3 *****
Centre	Zone 1 & 2 *****	Zone 2 & 3 *****	Zone 1 & 3 *****	Zone 1 & 3 *****	Zone 2 & 3 *****	Zone 1 & 3 *****

***** 5 stars denote maximum requirements on visual skill
****4 stars denote very high requirement on visual skill

Table 2: A summary of some of the visual skills associated with the different roles in basketball.

Visual Skill	Guard	Forward	Centre
Eye-hand coordination	• Field shooting attempts • Different Passing variations • Dribbling manoeuvres • Deny defence	• Field shot attempts • Lay-up attempts • Rebounds-defensive and offensive • Free shooting attempts	• Inside game situations • Free shooting attempts • Offensive rebounds • Defensive rebounds
Depth Perception	• 3point shooting attempts • Long pass reception	• 3 point shooting attempts • Frequent shooting from different positions under the basket area • Rebounding – Both offensive and defensive	
Eye-body coordination	• Off-ball cut movements • Dribbling movements • Setting screens and blocks • Free shot attempts • Frequent shooting attempts • Rebounds-offensive/defensive • Long pass delivery	• Off –ball cutting movements • Blocks and screens • Box out in rebounding	• Block movements • Box-out in defence • Pivot movements
Visual Reaction Time	• Passing the ball • Dribbling movements	• Off the ball cutting movements • Rebounds – both defensive and offensive • Shooting attempts from different locations • Jump ball during dead ball situations	• Jump ball during dead ball game situations • Rebounding (defensive/offensive) • Rebounds-both offensive and defensive • Shooting attempts under the basket • Block shooting attempts
Visualisation	• Quick lay-up attempts against the big men • Field Shooting attempts • Penetration passes delivery	• Lay-up attempts • Free shot attempts • Jump shot attempts	• Free-shooting attempts • Power drive in shot attempts • Offensive/defensive rebounds
Peripheral vision	• Defensive movements • Shooting attempts	• Rebounding the ball situations • Shooting attempts from different positions	• Rebounding the ball situations • Shooting attempts

Summary

Based on scientific investigations on sports vision (Gardner & Herman, 1995; Loran & MacEwen, 1995; Knudson & Kluka, 1997), success in sport performance is influenced by visual skills. Applied research in sport (Allard & Starkes, 1980; Allard, 1982; Gross, 1984; Davids et al. 1989; Barfield & Fischman 1990; Abernethy, 1991; McMorris & Beazeley 1997; O'Connor & Crowe 1999;) has shown that certain performance variables related to vision seem to characterise top-level performers. The question remains: are there visual skills that are specifically developed among expert basketball players? One of the main characteristics of any skill is its variability between individuals (Lyoka, 1996). Perceptual skills fall in this domain as well. Do expert players have normal vision and is it the ways in which they use that vision that is distinguishing? For example, perhaps the discriminating difference is the advantage in their visual search skills gained from specific adaptation in specific sports. They may have extraordinary abilities to perceptually "chunk"information in the brain that is composed of previous movement experiences as long-term memory. These chunks could facilitate the speed of information processing during performance in either new or familiar situations (Allard, 1982). A summary of the visual search strategies and the feedback of the decisions taken to complete the tasks are illustrated in Figure 5.

An expert player will be quick in accessing information specific to the sport from early cues demonstrated by another performer, and much of the precision in their decision–making is influenced by visual perception. Of course, visual perception by itself could not be sufficient to support top-level performance. Speed of information processing in relation to decision-making as well as the quality of the motor response must as well be considered. Expert players train not only to be able to execute accurate movements, but also to execute correct decision-making that will result in quality performances.

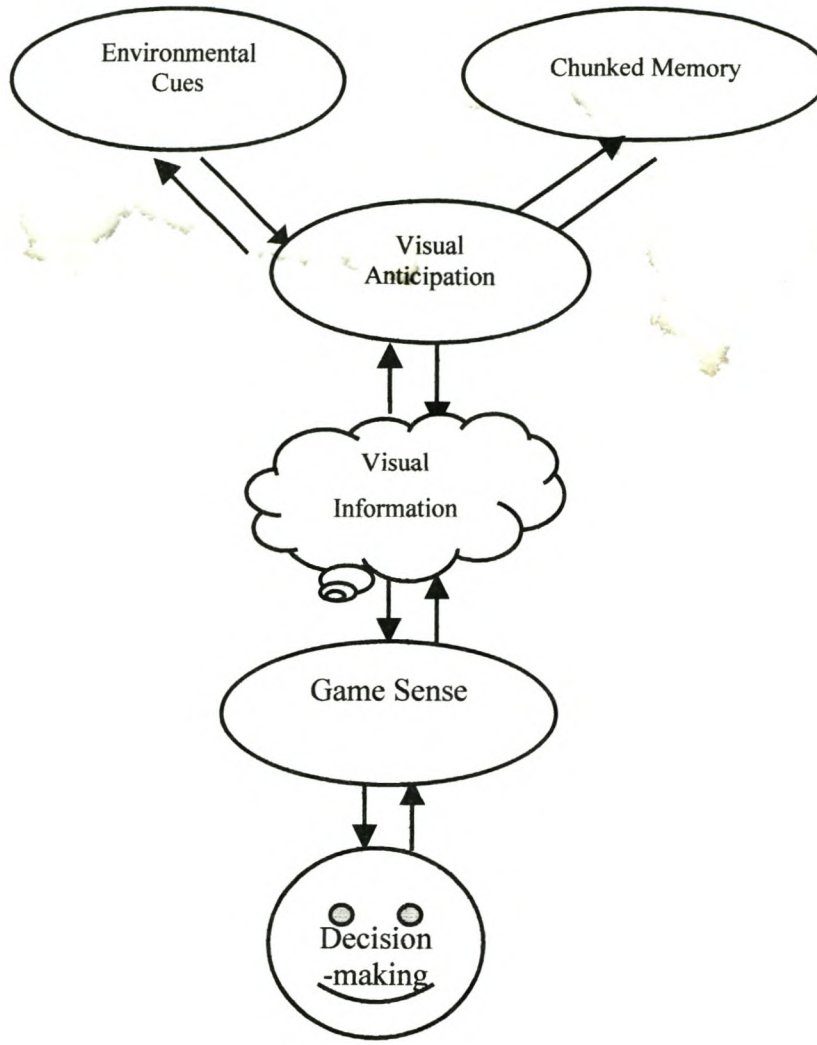

Figure 5.

Visual search strategies of expert basketball players

It is important to make it clear that the visual perceptual abilities alone cannot fully account for expertise in high strategy game situations. Expert performance also requires interaction among the visual perceptual abilities, decision-making components, and motor performance variables. However, the visual aspects of perception are important. Expert players are superior to novices in the speed, accuracy and prediction of perceptual responses when dealing with the sport in which they have specialized, such as football (Garland & Barry, 1991; Chamberlain & Coelho, 1993), basketball (Allard,

Graham & Paarsalu, 1980; Allard & Burnett, 1985), field hockey (Starkes, 1987), volleyball (Bard & Fleury, 1976), tennis (Goulet et al. 1989), and badminton (Abernethy& Wollstein, 1989). This expert dominance was found on the following:

- The ability to pick-up early cues specific to the task and to anticipate the next action accurately within the few visual fixations.
- The skills of selecting where to look and within that time allowed, seeing what is supposed to be seen in detail.
- The ability to use their visual focus quickly in selecting relevant from the irrelevant information.
- Expertise in choosing where to focus their eyes for reliable information.

Within the context of the ever-changing game situations, the quality of the flow of visual information contributes significantly to the quality of the decisions that are made. The visual system allows selection and identification of the most informative cues and the quantification of the selected information. With increasing experience, players are able to control their search strategies so that only visual cues that are immediately required will be scanned (Goulet et al. 1989). During vigorous game situations, frequency of eye-movements is increased and as a result, a large amount of information is collected from the environment. The ability to link the different bits of information cues in the ritual and preparation phases in relation to the different movements that will follow is effective with expert players and is therefore reflective of their superior visual search strategies. Although both expert and novices would focus on the ball, the expert's eyes would be not focused on one area. The information about what is happening away from the ball is also more important to him/her. The priority in scanning is based on what the potential source of information is and the eye fixations per unit time that are focused on specific areas. The quality of linking different pieces of information provides a coherent perception of the situation that is task-specific and meaningful at the present moment (Goulet et al.1989).

Chapter Four

Decision-making in Sport

Decision-making is not regarded only as a skill, but rather as an ability that encompasses different skills and processes. Decision-making has generally been defined as a process of arriving at a conclusion based on incomplete and uncertain information With regard to sports; decision-making has been conceptualized as a process of selecting appropriate responses about movement performance within the context of the game situation (McPherson & French, 1991). Both definitions include the concepts of "process" and "uncertainty" within the sport environment as important ingredients in any decision-making process.

Decision-making in sport is based on knowledge. The quality of decision-making has a determining affect on the level of expertise in sports. A variety of components have been related to the process of decision-making, including anticipation, recall and response selection, visual perception, active learning, memory retention, and game intelligence (Chase & Simon, 1973; Dorfman, 1977; French & McPherson, 1999; Goulet et al. 1989; Proteeau, Levesque, Laurencelle & Girouard 1989; Wrisberg, 1993).

Types of Knowledge and Decision-making

Two kinds of knowledge - declarative knowledge and procedural knowledge - have been reported to be critical in making correct decisions during sport performance (Allard & Brunett, 1985; Starkes, 1987; McPherson & French, 1991). They have been defined as follows:

- **Declarative Knowledge**

  Declarative knowledge is related to the concepts of the game and its interrelations, e.g. game concepts, rules of the game, goals, sub-goals, player positions, etc. "What can I do?" is the question that is answered by declarative knowledge. In the theory of motor learning, declarative knowledge is stored in the long-term memory (LTM) where it can be securely stored as a movement representation that is characteristic of the game

(Knapp, 1963). The concepts of offensive and defensive play in the game of basketball, for example, do not have to be re-learned every season by expert players because they are stored as declarative knowledge and can be retrieved even after many years of not participating in the sport. For example, a player learns the rules of the game once for all and they stay as long as one is actively participating. The game concept and its interrelations therefore stay long in the LTM and on that basis forming the foundation of other kinds of knowledge (Allard & Burnett, 1985).

- **Procedural Knowledge**

  This is knowledge that is related to the practical aspect of the game. The "How do I do it" question is answered by procedural knowledge. Procedural knowledge is linked to the tactics and strategies of particular game situation (Turner & Martinek 1994). Procedural knowledge is considered to be spatially related (Allard & Burnett, 1985)

Decisions about movement responses in open sport situations are based on both declarative and procedural knowledge – on knowing what to do and how to do it. In a basketball game situation, the player with the ball may decide to pass, dribble or shoot based on a number of environmental situations. The decision may be implemented immediately or delayed depending on several factors about the game situation that include the position of teammates, distance from the basket, time remaining before the end of the game, if the other team is leading the score, etc.

Within the context of superiority of expert performers, their knowledge repertoire influences the variability of the levels of decision-making. Within this framework of understanding, individual player decisions would not be similar between different game situations, i.e. the second decision may not be similar to the first one, because in both cases different game situations are involved. Similarly, individual players within a team may not make similar decisions during the game. Decision-making in a team sport is complicated because there are no similar decisions. Secondly a decision from one player may influence the quality of decision-making of another player.

Expert-Novice Differences

Studies in cognitive knowledge have been directly focused on expert-novice differences as a potential source of information in the quest to understand specific performance variables underlying expertise in sports. In open skill sports, decision–making is important because players have to keep up with the ever-changing game situations. Previous studies have identified some of the cognitive and visual perceptual abilities that influence decision-making in open skill sports. In the previous chapter, a description was provided of how expert players use visual perceptual skills to their advantage during game-related situations. During game situations, the frequency and quality of visual engagement with what is happening on the court supports not only the quality of information "input", but also the processing of that input in terms of anticipation, recall, and memory. These aspects are considered central in the processing of decision–making during game situations. They are identified as sources of expert-novice differences in sport performance (Chase & Simon, 1973; Starkes, 1987; Tenenbaum & Bar –Eli, 1993; Wrisberg, 1993; Ericsson & Charnes, 1994, McPherson, 2000).

Of particular interest to this study are the reported expert-novice recall differences in basketball (Allard, Graham & Paarsalu, 1980; Allard, 1982; Allard & Burnett, 1985; French & Thomas, 1987; Duke & Corlett, 1992; Allard, Deakin, Parker & Rodgers, 1993; Kioumourtzoglou et al. 1998a; Kioumourtzoglou et al. 1998b). These results have demonstrated that expert basketball performers are superior in recall ability within their fields of sports specialization. This recall advantage is accentuated by:

- Speed of perception.
- Efficiency in retrieval of information.
- Interpretation of incoming cues to create meaningful information patterns.

Anticipation

During competition, a defender on the ball handler has the task of mobilizing his/her internal performance capacities in response to the external uncertainties created by the decisions of the opponent(s). Similarly, his/her teammates are also in a state of uncertainty about will happen in the next moment. High levels of skill in performing offensive movements create increased risks of making an incorrect decision at any time during the game. Defending expert players continuously have the "what if" notion in their mind while negotiating a possible response. The offensive players have the "how" notion on their mind with regard to effective decisions that will lead to putting the ball in the basket. For the offensive player, it is not only one response that is planned then executed, but rather a response is initiated that has several alternatives. The final performance of one of the alternatives is guided by decisions about what the defense appears to be doing.

If one considers a typical situation in basketball, the complexity of decision-making becomes clear. A decision by one defender to leave his/her opponent and help in double-teaming the ball handler is always a risky one, although expert players do so very often. Based on their rich knowledge, they first evaluate the significance of the costs before deciding to help one another. An expert ball handler would read the situation and make a quick pass to the now uncovered teammate, who will probably take a shot. On the other hand, if the double-team works very well and the defenders take possession of the ball, then the decision was effective and the defense immediately becomes the offense. These quick changes in circumstances can only be dealt with effectively if players have enough time to think about them. This "time to think" is provided in part by developing the ability to anticipate.

Research on Anticipation

Dorfman (1977) conceptualized anticipation into three categories:

1. Receptor anticipation, which involves focusing on the most appropriate incoming stimuli through the visual and sensory systems. For example, when an expert player watches a game situation for a while, it is very probable that he/she can predict the next movement of the ball following an event because he/she knows

when to look for certain cues. Receptor anticipation was discussed in the previous chapter on sport vision.

2. Effector anticipation, which refers to the preparation for possible action within the muscles. The idea is that an elevated state of readiness for action will improve the timing and control of movement responses.

3. Perceptual anticipation, which refers to interpreting the information required for predicting situations. This interpretation is derived primarily from comparing experience with past events to the incoming information in relation to the present events in order to predict the next possible events. When the ball is played to the base line, for example, there are several options available for stopping the opponents from scoring and regain possession. The knowledge basis for deciding which option is best is gained from previous situations that may be relatively similar to the current one. When this knowledge is combined with current information cues, a decision can be made about an effective action.

This chapter will focus on perceptual anticipation since it is an integral part of the process of decision-making. An expert player must anticipate the movements of the opponent player on the ball, decide on an effective response and be at predicted place just before the opponent makes his/her move. The speed of processing the input cues and selecting the appropriate response is the player's *choice reaction time.* While time constraints are significant to the ball handler in deciding what to do with the ball, the defending player also operates under extraordinary time constraints before a final decision is made about when and how to react. In a study of decision-making in sports, Proteau et al. (1989) reported about trade-off between choice reaction time (CRT) and response initiation and this process increases the chances of a better coincidence –anticipation under natural game conditions. Anticipation can be learned and improved in order to maximize the accuracy of movement responses. Training can lead to specific adaptations of the knowledge structures as well as the motor execution components of the game.

With reference to expertise in sports, *flexibility* has been identified as a characteristic of anticipation and decision-making (Williams, 1985; Nettleton, 1986). Expert basketball players demonstrate high levels of flexibility in their decision-making. This means that they are able to adjust and re-adjust to the consistently changing game

environment within a fraction of a second and that the predictions are performed in a seemingly automatic way. This flexibility in anticipation and decision-making should be based on their cognitive knowledge about the game that has been derived from many years of practice and competition (McMorris, 1999).

According to Piaget in Dorfman (1977), improvements in the ability to anticipate events are correlated with age, in the sense that *timing* improves as players' age from 10-12 years onwards. Widmaier (1986) reported that anticipation and decision-making must take place at quick intervals, i.e. one hundredth of a second to facilitate timing of the motor responses. To an expert basketball player, the rapid identification and processing of task-specific visual cues are essential to meeting the performance challenges on the court.

Recall and Memory

In 1999, John McCrone, a scientific reporter for the *New Scientist*, published a report on current research about how the brain works. Although these findings were not entirely new, they presented dynamic descriptions of the brain's working systems.

> Individual neurones wired up to other neurones at junctions called synapses... 30,000 times... much smaller than a pinhead facilitate the nerve signals jumping from one neurone to the next across the synapse by triggering the release of a neurotransmitter, and the signal is rapidly picked up by the receptor molecules on the other side of the gap (McCrone, 1999:35).

Following the development of modern technology in brain scanning, new computerised trends of determining brain processes have evolved that can trace these firing patterns of neurons. According Fuxe of Karolinsk Institute –Sweden and Luigi of Modena University-Italy (in McCrone,1999), the fluid-filled spaces in the brain are used by the nerve cells to communicate in a large scale once an external signal is picked up. This widespread excitation of the nerve cells is called "volume transmission". Large regions of the brain are mobilized once a signal or memory trace is picked up for transmission. But once the stimulus has been recognized, the brain activity is reduced to specific levels within the short-term or long-term memory areas that seem to store the information needed to process the signal.

Scientific descriptions of how recall takes place have been limited due to (a) a limitation of expensive laboratory facilities for studying the brain working systems and (b)

lack of expertise in translating the results. Regardless of the development of sophisticated equipment for brain scanning, correct translations of the patterns of brain activity is still problematic. Descriptions about the "software mechanisms" for encoding and chunking of different game situations take place in the memory are still based on heuristic models (Allard, 1982; Starkes, 1987).

According to McCrone (1999), the brain accumulates thick strata of local routines as a result of intermittent practice, which produces the adaptations of perception and reaction patterns that allow fast retrieval and efficient processing of events to be automatically performed by the LTM. Expert and top-level athletes have highly established knowledge structures that perform specific monitoring tasks for smooth pick-up of the frequent signals for immediate transmission. Once an information signal similar to the stored memory is detected, a rapid self-firing mechanism takes place and the relevant memory configurations are set-up instantly. Within the context of accumulated expert knowledge, the effect of global transmission of the prefrontal cortex becomes reduced to the local systems. The process sets the LTM free immediately therefore enabling the expert player to pay attention to other environmental activities. It is as if nothing substantial is happening in the expert's mind with regard to the timely decisions that are being taken during the continuously changing game situations.

The ability to remember the past experiences and associate with the current game structural situations has an important influence in enhancing the quality of decision-making is sports. This ability is noticed among expert players in open team sports. Differences in expert-novice performances pertaining to the organization and use of declarative knowledge during vigorous and continuously changing game situations have been reported in several open skill sports (Abernethy, 1991; Starkes & Allard, 1993). Specifically, recall differences between expert athletes and novices have been reported under structured and unstructured game situations in volleyball (Starkes & Allard, 1983); chess (Chase & Simon, 1973); tennis (Goulet et al. 1989; French & MacPherson, 1999), hockey (Starkes, 1987; soccer (McMorris & Beazeley, 1997) and badminton (Abernethy, 1991).

The Recall Paradigm

Investigations into the mechanisms that support recall are not new. A report by Chase & Simon (1973) when analyzing the amazing recall patterns of chess masters, first introduced the idea of "information chunking" or the grouping of multiple cues into a single unit for processing. They hypothesized that recall is dependent up on the prior coding of meaningful "chunks of information, and the labeling and storage of these chunks labels in the memory, then subsequently decoding the chunks at the time of recall.

The notion of chunking advanced by Chase and Simon (1973) has been studied by a number of researchers in sport (Allard et al. 1980; Allard, 1982; Allard & Burnett, 1985; Williams, Davids, Burwitz & Williams, 1992, Garland & Barry, 1990). Garland and Barry (1991) studied football experts and Williams, Davids, Burwitz and Williams (1993) studied soccer experts. They observed that experts recall large perceptual chunks within the first 5 seconds of viewing but only for structured game situations.

In reference to the knowledge of volume transmission, the brain processes of coding (perceiving), decoding (translate to make meaning) and chunking (organizing) of information must be coherently related (McCrone, 1999). External stimuli about a specific task must be recognized (coded) and associated and assimilated with the stored memory configurations (decoded). At the same time, detailed organization of the information structures associated with internalized alternatives gets completed (chunking).

The expert performer is distinguished by his/her procedural knowledge about "how" to accomplish a goal in a movement situation (Abernethey, 1991). While information may be stored in the LTM, there are situations in a game that require immediate response and for that, procedural knowledge stored in the STM comes into play (French & Thomas, 1987; Starkes, 1993; Kioumourtzoglou et al.1998a). The idea of having knowledge stored in the STM is important for the immediate decision-making about applying game tactics. Because the brain has an established hierarchy of information storage that is limited in capacity i.e. frequently used information is stored temporarily in the STM for speedy retrieval, experts must consciously think about what is happening in a game so that relevant chunks of information can be drawn from the LTM to the STM for use during a particular part of the game. For example, if an expert player cannot shoot the ball due to pressure by the defense, a pass could be one of the alternatives. The chunked

information about shooting, passing and dribbling must all be readily accessible in the STM. Selection of the appropriate responses will be possible because the expert has chunked his/her memory configuration for all of these skills. The final decision can be based on superior recall of past game situations compared to what the immediate situation appears to allow.

Measurement of Recall

Previous measurements of recall using structured and unstructured game situations have contributed to the understanding of the cognitive advantage of experts in sport. (Wrisberg, 1993; Abernethy, 1994). The experimental design by Williams et.al, (1992) in their study of recall in soccer games provides an example of a method that is close to the ecological conditions. Video films of different structured and unstructured game situations were collected from different league games. To measure recall of the subjects, expert soccer players and novices viewed these games for a period of eight seconds per viewing. Later, subjects were asked (a) to give verbal answers on what they had seen and (b) to reconstruct the game situations on a soccer field drawn on the table. Expert players performed better in both verbal answers and the reconstruction of their knowledge, therefore confirming the previous findings on cognitive advantage of the expert players in terms of their sport-specific knowledge.

Current literature review on expert-novice differences in recall shows that expert ball players including basketball top-level performers are superior in retrieving information that is purely relevant to their knowledge of the sport. A comprehensive study of the analytic ability, grouping and organization of information and retention among elite basketball players showed that they were similar to elite players in volleyball and water polo. They demonstrated cognitive ability specifically related to the knowledge gained in their sport of specialization. As demonstrated by Kioumourtzoglou et al. (1998b), recall of expert and novices would be similar if the performed task is new to each of the two groups of subjects. This demonstrates that prior information in the LTM is significant in facilitating the quality of recall.

Expert Decision-making in Basketball

The ability to evaluate the current situation, taking into consideration past related events and prediction of the future outcomes, is essential for making accurate and timely decisions. Within the cognitive context, this clearly defines the challenge in sports performance (French & McPherson, 1999). Generally, expertise within the different sport domains, including basketball, is demonstrated by the efficiency of linking the ecologically dependent information with the internal related configurations of knowledge in the LTM. Specifically, expert athletes demonstrate high match-up of the LTM information with the external information originating from the complex game situations to produce dynamic decisions that are made with speed and accuracy and flexibility.

Efficiency in encoding/decoding and chunking of the relevant game signals results in optimal capacity for transmitting volumes of information, and influences the creation of a repertoire of recall information for consequent dynamic decisions in structured game situations. Chunking is the ability to organize the stored information into memory patterns (configurations) while coding/decoding of information refers to processes of recognizing and storing the relevant information configurations (Allard, 1982).

In a complex strategy team sport like basketball, two conditions should be considered as underlying the formation of task-specific knowledge in decision-making:

1. Individual game uncertainties must be understood in order to optimize performance in specific situation.

2. Levels and types of interaction among teammates and opponents must be "read" and interpreted in relation to the specific situation.

Decision-making in basketball typically takes into consideration the positions of the players on the court, time remaining in the game, and responsibilities of each player within the game strategy, and the amount of pressure from the opponents. A decision about whether or not to speed up or delay a pass will depend on one of these factors at any given moment of the game. With increased training and frequent competitions, the task-specific perceptual and cognitive qualities of decision-making can be learned.

The adeptness of the basketball player in selecting the correct response is one of the critical measures that define expertise in the game. Top-level expert basketball players have specific game adaptation levels that influence their decision-making processes to be attention free and performed in more of a natural way. Sport-specific analytic ability, organization of information, memory retention, game intelligence and active learning has been identified as expert abilities in high strategy sports like basketball (Kioumourtzoglou et al. 1998a; 1998b).

- **Analytic ability**

  Experts in sports have a large base of task-specific knowledge that is highly developed to measure up with the complex and quick decisions that may be required in game situations. Analytic ability is the ability to search, recognize and perceive cues from the environment and then link these external related cues to the internal patterns in the LTM, which in turn will lead to a tactical decision about movement performance.

  Different levels of individual cognitive adaptation have been found in experts' abilities to perceive sport specific information from the environment, the speed of processing in the LTM, the rapid retrieval of the relevant information patterns and the organization of information for accurate decision-making (Allard, Brunett, 1985; Garland & Barry, 1990). The amount and quality of engagement time available for training and the frequency of participating in competitions significantly strengthens the interaction of the ecologically originating information with the internal LTM game patterns for enhancing quick and accurate decision-making (French & Thomas, 1987, Tinberg, 1993). The expert player perceives and cognitively arrives at decisions based on in-depth knowledge (Starkes, 1987; Chamberlain & Coelho 1993; Helsen & Pauwels, 1993; Kioumourzoglou et al. 1998a; 1998b; French & McPherson, 1999).

  The different levels of expertise in DM demonstrated in basketball are therefore attributed to the perceptual and cognitive proficiency of accessing and using task-specific information. Expert basketball players perceive patterns of information and not individual stimuli and therefore their decision-making processes are guided by rules. These rules include the efficient use of the early cues for quick

recognition and the retrieval of relevant information in the LTM (Ripoll, 1991; Tenenbaum & Bar-Eli, 1993; Kioumourtzoglou et al. 1998a; 1998b).

- **Organization of information**

  Expert players have the ability to group and organize information necessary for efficiency and speed in making the complex decisions that must be made during game situations. The coach can provide support. During timeout sessions, for example, the players can share ideas with coaches with regard to tactical decisions. The opponent's weaknesses and strengths in both the defense and offense in comparison to their team strengths and weaknesses form the main part of the decisions. Any changes that will be made are geared at gaining superiority in ball possession and therefore increasing the chances of scoring.

- **Memory Retention**

  Effective memory retention is one of the qualities of expert basketball players. The incoming patterns of information demand a high working capacity in the LTM in terms of processing and retrieving related information for efficient recall of the game situations. This state is achieved once there is a matching of the environmental information with the information that is in the memory (Wrisberg, 1993). The STM becomes the working space for tactical decisions and the execution of the different patterns of information with speed and accuracy. In a way, the immediate functions of the STM reduces the processing load to the LTM and therefore keeps the LTM free and ready to take-up more incoming messages (Helsen & Pauwels, 1993). The advanced interactive capacity of the LTM and STM enhances the performance quality of the expert basketball players because it supports quick thinking and quick choice reaction time. At any given moment, expert basketball players are aware of the situation of the ball handler as well as the players away from the ball. This increases their chances to make correct decisions.

- **Active learning**

  Active learning refers to experts' ability to learn in supervised and unsupervised situations. If a pass has to be performed, for example, one needs early cue recognition, preparatory cues, selection and execution of the pass. The selection of all these movement patterns involves the LTM and therefore any novel task

gets stored as a new information configuration. Regardless of the level of expertise, any new situation is an opportunity to learn if the individual player is paying attention and thinks about what is happening. Professional basketball players practice the techniques of lay-up, dribbling, passing and so on. The idea is not only to retain what they already have learned, but to introduce small changes that will expand their knowledge base and advance their decision-making capabilities (Goulet et al. 1989; Ericsson & Charnes, 1994).

Active learning involves a kind of tuning process. For expanding procedural knowledge, it is important that learning opportunities are continuous and that the transformation of the skill performance into configurations of task-specific knowledge structures is sustained. "Tuning" has also been associated with knowledge generalization, a process in which the rules for applying knowledge are tested and sorted so that more accurate rules to guide decision-making are developed (Starkes, 1987; Helsen & Pauwels, 1993; Turner & Martinek, 1994).

Game Intelligence

A study of the nature of intelligence by Tenenbaum and Bar-Eli (1993) provides a solid framework for understanding the use of intelligence in highly strategic sports. Expert athletes demonstrate high capacity in coping with complex and ever-changing game situations. This intelligence seems to be expressed by the memory structures of individual athletes. The ability of an expert basketball player to select the kind of pass and then to time the pass to a teammate who makes an explosive turn and jumps high towards the basket, demonstrates a kind of intelligence. Before the pass, an expert player considers many factors, including the selection of an appropriate pass, the speed and trajectory of the ball, etc. Fisher (in Tenenbaum & Bar-Eli; 1993) identified the following task that must be performed by the expert during responding to the different situational factors in a changing environment:

- Locate, search and correctly perceive the important cues that identify the nature of the environmental conditions.
- Sort out the essential cues for the task in the current situation.
- Identify internal related structures in the recall memory.

- Use the short-term memory to plan actions e.g. change tactics, game structure, substitute players or switch players to match the tactics of the opponents.
- Use the LTM efficiently to recall the basic principles and strategies of the game.
- Carry out effective and timely decision-making that is task-specific

Evaluation of the game performance could be added to this list as an important measure for future adjustment of the strategies and tactics of the team.

In a study of soccer expertise among young players, Ripoll & Benguigui (1999) mentioned intelligence as associated to the ability of problem solving, retrieving declarative knowledge from the long-term memory, matching (comparing) the contents of external information to stored information for production of rules and the selection of response that reflects the match found. From this description, it would appear that sport intelligence is the ability to select the kind of skills that are needed and to perform them in an accurate and effective manner. In basketball, the selection of skills for execution is shaped by the opposition and time constraints during the game. The capacity to see complex game situations and to select, process and recall task-specific information is highly developed in each player. In consideration of all these characteristics, there is an element of individual intelligence within the expert basketball player. Unfortunately, cognitive psychology has not yet fully established the specific kind of intelligence that is developed by this expert.

Summary

Studies on expert-novice differences have been pursued to establish the possible locus of expertise in high strategic sports performance. Expertise is surrounded by the task-specific individual differences in perceptual and cognitive abilities. In both components of performance, the organization and interaction of declarative knowledge and procedural knowledge on one hand, and in interaction with the ecological information on the other hand, is a critical determinant of who is an expert in a specific sport. The following characteristics have been discovered:

1. Experts possess cognitive structures specific to their sport specialization and that they demonstrate high levels of interaction between their long-term and short-tem memory structures (Allard et al. 1980; Allard, 1982; Allard & Burnett, 1985; Starkes, 1987).

2. Experts take in large amounts of information for depth in coding of the relevant information; they demonstrate effective utilization of knowledge (Allard & Burnett, 1985; Williams et al. 1993, McPherson, 2000).

3. The superior recall capabilities of experts are reflected in the way task-specific information is organized in the memory. Instant retrieval of information is accessed once the corresponding stimuli are matched up. Large amount of task-specific knowledge configurations in the LTM enable experts to quickly verify information before accurate and effective decisions are made (McPherson, 1999).

4. Experts demonstrate high levels of flexibility in decision-making under complex decision-making game situations (McPherson, 1999).

Decision-making in sport can be regarded as a collection of inter-related skills and abilities within a specific performance context. The speed, accuracy and flexibility of decision-making appear to be distinguishing characteristics of the expert basketball player.

Chapter Five

Expertise in Motor Performance

Logically, a motor expert is someone who is highly skilled in performing motor skills. There are motor experts in dancing, running, typing, surgery and so forth. The definition of motor expertise can also vary with cultural and environmental difference, including being used as a term relative to different performance levels (Starkes, 1993). In the Wagogo[1] traditional game of "naga[2]", for example, it is possible that an expert player is identified within a given community, who may not measure up very well against other experts from the neighbourhood community during organised competition. Norwegian children of 12 –13 years could be described as experts in cross-country skiing. This demonstrates that cultural and environmental conditions therefore can have an impact on the definition of motor expertise.

In sports, motor expertise is a term used to describe athletes who are highly skilled in their specific sports. Starkes (1993) described them as being two to three standard deviations above the normal in terms of motor proficiency in their sport. Abernethy (1993) defined motor expertise as "possession of a large body of knowledge and procedural skills"(p. 325). As a result of many years of training and competition, they have developed specific psychomotor and physiological adaptations highly suited for their sport.

In minimal strategy sports like gymnastics, the environment does not change substantially during performance. The height and width of the apparatus remains the same for example. In highly strategic sports, however, such as the open skill based team sports, the dynamic nature of the conditions in each specific sport environment must be

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[1] Wagogo is a tribe in Dodoma region-central Tanzania where the author was born.

[2] Naga is a stick/club game relatively similar to baseball but the ball is self-tossed and hit as far as possible towards your own community area. Two teams of an unlimited number of young men from neighborhood communities would compete, usually after the harvest season. The game starts at the boarder separating the two communities. The winning team is declared if the game is sent back and the ball is played right in the middle of its own community.

understood and mastered. Players depend on anticipation and flexibility in decision-making to execute different movement responses to different situations. From this perspective, motor expertise may be defined operationally as specific adaptations to the performing environment (Goulet et al. 1989; Abernethey et al. 1993; Allard, 1993; Starkes, 1993; Abernethey et al. 1994; Ericsson & Charnes, 1994; Singer & Janelle, 1999; Starkes et al. 1999).

Motor Skills and Abilities

There are different understandings of the term "skill." In sports, the definition may vary according to the levels of performance and specialisation (Knapp, 1963). To a basketball beginner, the acquisition of skills can be seen as the progressive automation of movements with the ball with optimal consistency. In the literature on sport expertise, skills are regarded as a product of experiences gained from specific environment adaptations (Starkes et, al. 1994). With intentional training organised over an extended period of time, higher levels of skill adaptation are possible.

In a study of components of performance based on expert-novice differences in cognitive and skill execution in youth baseball, French et al. (1995) concluded that the skill component significantly differentiated levels of expertise. A study on skill in ball juggling by Beck in Abernethey et al. (1994) demonstrated that as a result of increased motor expertise, players are able to extend their experience and therefore achieve increasingly high skill levels of balls juggling. Increased adaptation and flexibility of the motor is one of the characteristics of expert performers.

A study of performance skills in volleyball in the 1994 world champions and the 1995 European champions presents interesting results. Quantitative data was analysed to compare the skill advantages between the two finalist teams – Italy and Holland (Katiskadelli, 1998). The successful performance of the Italian team compared to the Dutch team was based on the quality of skills demonstrated in the short distance serves and use of first tempo attacks with great accuracy. A comparative analytical study of the European volleyball teams and the club volleyball teams in attack serve was conducted following the 1994 World Volleyball championship (Katsikadelli, 1996). The superiority of the European teams was based on their high skill levels related to accuracy of timing the

ball. The great success of both the world and European teams was mainly in their advantage in accuracy of executing the jump serve skill.

Efforts to identify the abilities that distinguish expert athletes have been challenged due to the hidden and broad nature of the human abilities that cannot be easily captured by one experiment (Allard, 1993; Starkes et al. 1994; Thomas & Thomas, 1994). Several studies have attempted to identify certain *variables* that are associated with success in sport performance. In soccer, certain physical fitness components were seen to be important in influencing the performance of skills required in the elite game (Allen, Butterly, Welsch & Wood, 1998). In female gymnastics, depth perception, dynamic balance and kinesthesis were found to be characteristic of successful performers (Kioumourtzoglou et al. 1998b). In water polo, experts, kinesthesis, decision-making, visual reaction time, spatial orientation and group organisation were found to be characteristics of experts (Kioumourtzoglou et al. 1998c). In a study of youth rugby players, selected physical and motor abilities were determined to be significant predictors for success among young players (Pienaar & Spamer, 1998).

Starkes, Allard, Lindley and Reilly (1994) defined abilities as general, stable traits of the individual which, under given practice opportunities, may facilitate performance in varying tasks. These authors emphasised the significance of a constellation of abilities in the selection of athletes at different levels of participation. However, the correlation of abilities measured in the laboratory to the natural world is as low as –4 to 0.4, which is less than 50% of the variance. These low levels of correlation cast doubt on the usefulness of current approaches to the identification and measurement of abilities.

Abilities as "stable traits" include those that are *inherited*, include height, morphology, VO_2 Max and speed (Ackland & Kerr, 1997; Singer & Janelle, 1999). With training, such abilities can be maximised for application in certain sports. Young Maasai warriors are famous for spot jumping during traditional dances, which is evidence of their spot jumping ability. If a group of them are recruited to play basketball, they need to be introduced to specific basketball jumping techniques before they can take the dunking shots. Learning such a basketball jumping technique may take less time for the Maasai youth compared to a young man picked up from the local school. There will be a quick transfer of the skill from spot jumping ability to basketball quick jumps.

It is believed that expert basketball performers have advanced levels of motor co-ordination both with the ball and away from the ball. Their specific basketball movements have been well integrated with their movement abilities. The intriguing question is the proportionality of the integration of abilities and skills during execution of such skilled movements with the ball. Do expert basketball players depend on skills only? Do teachers and coaches prepare exercises that cater for the development of both skills and abilities? There is still a lot of missing information as far as motor expertise is concerned in sports.

Research about Motor Expertise

Studies in sport expertise have focused on visual perceptual abilities (Bard & Fleury, 1976; Starkes, 1987; Abernethy, 1991;1993) and cognitive abilities (Allard, Graham & Paarsalu, 1980; Allard, 1982; French & Thomas, 1987; Allard 1993; French & Nevett, 1993; McPherson, 1993). Although deliberations on motor expertise may have been mentioned in some of these studies, it was not the actual focus of the investigations. This has contributed to a dearth of relevant literature on motor expertise. Previous studies have not really investigated motor expertise per se, but treated motor expertise partially while focusing in cognitive expertise (Bougeurd & Abernethy, 1987; Abernethy et al. 1993). Other observations are that one cannot study motor expertise without touching perceptual skills.

Generalisations on laboratory-based paradigms in motor control and motor learning research have provided limited information about motor expertise in real-world sport situations. Much of what takes place in the natural world is not accounted for by the current research on motor control and learning. Motor performance in the natural environment of open skill sports is dominated by great performance uncertainties with time constraints. In their efforts to understand motor expertise in sports, different researchers have favoured either the bottom-up or top-down approaches. The bottom-up approach involves firstly, an analysis of a sport domain to determine the dominant performance factors that may be related to the development of expertise. The approach seeks to gather quantitative and qualitative data for a comparative study between either young expert-novice groups or adult expert-novice groups. The aim of the approach is to determine if there principles that discriminate between experts and novices, and whether these principles are generaliseable across other sport domains (Starkes, 1993). Parallel to this

approach are studies on individual differences that are based on abilities (Wrisberg, 1993; Singer & Janelle, 1999) and information processing skills (Wrisberg, 1993; Thomas & Thomas, 1999).

The Top-down approach probes the performance characteristics among elite performers on different levels of performing skills that are highly familiar (Starkes, 1993). The study of the chess masters (Chase & Simon, 1973) is one of the classic examples of experiments taking this approach. Similar studies have been previously carried in basketball (Bard & Fleury, 1976; Allard, Graham & Paarsalu, 1980). Different methods may be used in both approaches, but it is the validity of the data collected and if the method adopted is reproducible.

Based on these approaches, previous studies have addressed motor expertise in a limited way that is more focused on individual sports or athletes and less on team/group sports. Basketball is typical of those open sports that are highly strategic in perceptual, cognitive and motoric aspects. The study of motor expertise in these open sports needs to take into account three dimensions when evaluating performance:

1. The *individual player* – with his/her own strengths and weaknesses,
2. In *relation to team-mates* - how much are the individual player's movements co-ordinated with those from other members in the same team so as to form a team chemistry?
3. In relation to the *opponents* - who must create the uncertainty that allows the individual player to demonstrate his/her level of expertise?

A strongly worded paper cautioning sport science researchers about ongoing weaknesses in the study of motor expertise was published by Abernethy et al. (1993). They criticised the continued reliance by sport scientists on the cognitive psychology approach that is more theoretical than practically oriented. Abernethy et al. (1994), encouraged an examination of motor expertise froom different perspectives, including the neurobiological and ecological paradigms.

The Neurobiological View

The neurobiological determinants of motor learning and skill development are based on the cortex, the basal ganglia and the cortical-spinal pathways down to the peripheral parts of the muscular system. The information that drives the operation of these highly sophisticated mechanisms originates from the senses, particularly the visual sense. (Pillard, 1977). The control of the commands from higher levels may be in the form of pre-synaptic inhibition of some input and the muscles or intervention at various points where signals about the action are filtered. The central area of the brain performs the final filtering and provides feedback about the correctness of the executed movements and is therefore the significant organiser of the quality of the performed movements in sports (Pillard, 1977). From this perspective, motor expertise is dependent on the efficiency of the neuro-motor commands and the dexterity of the muscles and joints in performing the required tasks (Abernethey et al. 1994). A recent study of neuroscience has reported that the brain is dynamic in the context that it can interface neuro physiological brain activity with morphology of the body to influence changes of human movements (Keil, Holmes, Benneth, Davids & Smith, 2000)

The Ecological View

Within the ecological perspective, performance is a dynamic interaction between the individual and what the environment offers (affordances) and what it limits (constraints). Vincente and Wang (1998) proposed the "constraint attunement hypothesis" in relation to the environmental changes and expertise. Their theoretical position was based on the conception that skill acquisition is a process that requires specific adaptation to the imposed environmental constraints. Although the study examined only one aspect of ecologically based expertise, i.e. recall memory, there is possibility that with given time, the knowledge of motor expertise in the ecological theory will be established. It is possible to speculate that expertise in sport is dependent upon the ability to "specifically attune" one's performance to the changing game situations.

Limitations in the Study of Motor Expertise

Despite the practical problems experienced by athletes and their teachers/coaches in solving movement problems, there has not been enough written on motor expertise per se. The theory of motor control and learning and that of cognitive psychology has had serious repercussions on the development of the knowledge on motor expertise (Abernethy et al. 1993). The science of cognitive psychology has grown on the expense of the motor control and learning. Experimental studies in cognitive psychology have been using motor control and learning experiences to explain the development of some of its theoretical principles and methodological approaches

Research about "expert players" emerged when De Groot studied the structure of memory in perception of chess "masters (Chase & Simon, 1973). The term *master* literally referred to someone who was more expert than the rest of the expert players. Current research includes the study of a variety of variables, including biomechanical, exercise physiological and sociological (Abernethy et al. 1993). The study of motor expertise has become both multidisciplinary and interdisciplinary.

Although previous studies have been instrumental in provocative thoughts on motor expertise, their findings have been limited by the methods used. This tendency has triggered increased interest in studies that are close and even originating from the natural sport conditions (Abernethy et al. 1993; Abernethy et al. 1994). The "traditional explanations" of sport expertise were based on "borrowed knowledge" from cognitive psychology that emphasised the information-processing paradigm. The athlete must think, select the movement and finally execute (Glencross, Whitting & Abernethy, 1995).

In view of the above limitations, knowledge about motor expertise is far from being organised. Even the definition of the term "expertise" is sport remains problematic. A less skilled basketball player, when compared to a novice, may feel like an expert. A professional basketball player is considered to be "more expert" that a national player. A university basketball player can be expert if compared to a college player. A 12-year old child can be expert if compared to less-skilled players of the same age group.

Logically, the notion of sport expertise must have originated from empirical observations of skilled movements of players in different sports during training and competitions. It therefore makes sense to include the motor aspect of expert performance

rather than to focus only on perceptual and decision-making aspects of expert performance. It is assumed that the physical skills of the basketball player are the indicator of athletic and not underlying performance expertise. Expert basketball players demonstrate great ranges of movement variability with flair and control. Based on these levels of motor excellence, research should be focused on the discovery of how expert performance is developed, promoted and maintained for long periods of time, e.g. a career.

The Development of Motor Expertise

Based on information gained from different studies, the following are considered to be among the top-rated mediating factors in the development of skilled performance and the achievement among different athletes (Singer & Janellle, 1999; Starkes et al. 1999; Ericsson, 2001):

- Deliberate practice, including time considerations, the content of practice, fitness aspects of practice and player attitude.
- Genetic factors.
- Professional supervision.
- Facilities.
- Diet.
- Health status.

Previous studies have not identified the importance of *opportunities for competition* in the development of expertise. However, deliberate practice alone cannot guarantee expertise in sport. Being successful in sports means getting down on the court to demonstrate what has been acquired. There are players who are not successful in their sports simply because they fail to demonstrate their proficiency during competitions. For this reason, opportunities for competition have been included in the following discussion of deliberate practice.

Deliberate Practice

Deliberate practice is focused practice and the focus is on skill improvement. The amount of intentional practice has a significant contribution in the development of motor expertise. Unlike declarative knowledge that may be acquired through observation, procedural knowledge and motor expertise requires one to get up, put on specific gear and go to the field or court. A teacher or coach will be there with a well-established training programme for whatever is to be practised per session. If well formulated and followed adequately, deliberate practice is an important ingredient of the recipe for preparing, maintaining and promoting motor expertise (Ericsson, 2001). In the context of practice, expert players need a high volume of frequent practice at a level of intensity close to competition conditions. Several studies have reported the importance of deliberate practice in the acquisition, maintenance and promotion of expertise (Ericsson et al. 1993; Ericsson & Charness, 1994; Starkes et al. 1994; French et al. 1995; Singer & Janelle, 1999; Starkes et al. 1999).

There are other issues related to deliberate practice with respect to motor expertise. Chase & Simon (1973) suggested a "ten-year rule" of practice before expertise acquisition. With modern technological development in training facilities, health care and professional knowledge, there are players that become experts more rapidly. Michael Owen (Liverpool and England team player) and Ronaldo De Lima (Barcelona and Brazil team player) were recruited and included in the national teams and professional clubs when they were between 18 –19 years.

Studies on growth and skill development also present a challenge to the 10-year rule, since performance improves within the bounds of maturation (Starkes et al. 1999; Thomas & Thomas, 1999). Singer & Janelle deserve credit in their argument against the 10-year rule. Deliberate practice starts when the child has reached a certain age that allows accessing concentration and therefore paying attention to what is being said or done. Before this age, a child does not qualify for inclusion in such a tough training regime geared at the acquisition of expertise. Parents, teachers and coaches are wasting time and effort by pushing their children into hard exercises prematurely. A continuum of practice over a long period at varying levels of volume and intensity according to maturation is important, and at the end, a player will naturally fall in the expert group of a specific sport domain (Singer & Janelle, 1999).

Practice Time

The amount of time allocated per practice session and the quality of its use is critical feature of deliberate practice. According to Ericsson (2001):

> With increasing age, the involvement of future expert performers increases, and toward the end of adolescence, their commitment to the domain-related activities essentially becomes full time (p. 10).

It is difficult to specify the exact amount of time that must be invested because different sports may have different requirements. Elite basketball players, for example, spend between five-six hours per day on the court training. They may spend additional time training on their own.

Once the level of expert is reached, the amount of practice that must be invested in maintaining excellence has not been studied well. Based on the amount of practice and time invested, experts do seem to maintain their performance over long periods of being active regardless of the gained age (Starkes et al. 1999). A general observation is that experts continue to invest large amounts of time in deliberate practice throughout their training year.

The Content of Practice

Both the structure and content of the training programme should be well formulated if it has to make expert players achieve their aspirations. A programme that aims at maintaining expertise and improve performance must be one that is varied yet focused on the production of quality motor performances. Whatever there is to be learned and changed, or modified, must be integrated into the context of the game, which is why practise should reflect the expected competitive environment (Morton, 1997; Ericsson, 2001).

Because the opposing players determine a large portion of constraints within the game, the structure and content of practice must reflect the opportunities for competition (Ripoll & Benguigui, 1999). In basketball, the speed-accuracy trade-off requires the defensive player to execute an accurate response within the time allowed by the offensive player on the ball. What to see and where, the speed and accuracy of decision-making and maintenance of spatial balance during the different uncertainty of a game situation, all

must be reconstructed and practiced adequately. Much of what happens during the game is dependent on interaction of decisions among the players. Expert players need to have their practice organised in such a way that the quality of their decision-making is tested for further improvement.

Fitness Aspects

With extended deliberate practice, expert players not only assimilate the strategy and tactics of the game, but also improve their sport-specific physical fitness. The effective use of small game situations to promote sport-specific physical fitness of players in a team sport has been reported in soccer (Allen et al. 1998). Intensity (hence workload) is increased by reducing the number of players on the ball and increasing the number of movement variations performed per unit time

Although coaches may think they know the working intensity levels demanded of each of their players in each of their positions, precise knowledge is not available about the exercise intensity that will sustain motor expertise in on-field sport-specific situations. In English and Australian soccer, it was reported that players covered 98% of their total distance, running away from the ball (Reilly & Thomas in Withers, Maricic, Wasilewski & Kelly 1982). That was equivalent to almost 12,000 metres. Based on such results, the practice sessions of top-level players must include a focus on the development of running endurance.

Player Attitudes

Related studies have identified quality of engagement time (Tinberg, 1973; Lyoka, 1996) and specifically, "working hard" as attitudinal considerations that are important for expert performance and retention of expertise. Hard work is closely associated with the development of expertise (Ericsson, 2001). In basketball, there is little possibility that one can improve to become expert player without hard work. In a study of predictors of expertise, Thomas & Thomas (1994) interviewed physical education teachers. These teachers reported that some of their students who made it to the NBA worked much harder during practice than other students. Teachers were proud to have them in their teams. Although hard work has not been specifically measured, it has a significant contribution

toward high-levels of achievement. It is one of the criteria for sustaining the effort to develop expertise.

Opportunities for Competition

Practice and competitions are two different faces of the coin of motor expertise. Practice is supposed to replicate the expected competitive constraints and as well as facilitate the transfer of the skills and knowledge to the "real" competitive situations. A coherent view of what constitutes sport expertise by Singer & Janelle (1999) described clearly the performance problems if practice is provided without sufficient exposure to competition. However, specific research is lucking on how expertise can be nurtured and promoted over several years.

Genetic Factors

It has been reported that elite performers are highly responsive to both general and specific training, i.e. their systems adapt quickly (Singer & Janelle, 1999). However, the threshold of responsiveness varies on individual basis. In team sports, such a variation takes time and does not happen at once. One of the factors that contribute to physiological adaptability appears to be genetic endowment. However, some studies have downplayed the role of genetic endowment in sport expertise (Ericsson et al. 1993; Ericsson & Charness, 1994) specifically indicated that genetic affordances in the development of expertise involve only the variables of height, weight, and other anthropometrical variables. He mentioned nothing about the capacity for physiological adaptation. This is obviously an area that requires a great deal of future research.

Professional Supervision

The development of expert performance requires top-level teaching and coaching. Elite players are usually comfortable with their coaches and enjoy working with them and their coaches feel the same way (Singer & Janelle, 1999). But good relationships are not enough. Coaching expertise in the form of knowledge about what to communicate and how to communicate that knowledge is important. Top-level sport performance, coaches do not perform, but rather must be able to teach the players "the what to do and how to do it" (Thomas &Thomas, 1994, Morton, 1997, Jackson & Charles, 2001).

Coaches also must be prepared to learn from the mistakes committed by their players (Allard, 1982). Observing and understanding the performance limitations of a particular player is critical for a top-level coach (Turner, Allison & Pissanos, 2001). As far as the skills of communication are concerned, the timing of what is to be communicated and how it is to be communicated is important to the coach. Allard (1982) provided an example of a knowledge communication in basketball. During practice and competitions, professional coaches use tactic boards to communicate their views on game tactics in relation to what the opponent team players are playing. Expert players have the task of transferring whatever is seen from the sketches into relevant information. Next, basketball players have to apply this information as they communicate on the court. Expert players seem to be quick in picking meaning from what is seen and quickly select what is important at the current game situation. In post-competition analyses, coaches use video films and statistics taken during games to analyse players' performances and to discuss their performance with them.

Other studies have recommended that coaches use inferential statistics in coaching team sports as an effective way of predicting performance of the team (Onwuegbuzie, 2000). Strategic decisions about whether to play a more offensive or a more defensive game are based on different data collected from previous games. These decisions take into account the team strength and weaknesses as well as the importance of the game in winning the championship. During the game, significant problems pertaining to either cognitive or motor skill execution are noted. If the problem is related to skill execution, how early should such a feedback be given to the player to affect movement accuracy?

Research on the timing of the delivery of information to the expert players would be useful to the expert coach. Players focus on what is emphasised by the teacher/coach (French & McPherson, 1999) and this may have major influence on their ultimate development of their ultimate level of expertise. There could be a highly knowledgeable coaches who could not maximise the development of expertise among players because he/she was unable to communicate information at the optimal time for it application.

Facilities

The type, quality and quantity of athletic facilities and equipment have significant influence on motor expertise acquisition and retention (Ericsson 2001). The facilities that are provided should be built according to the international standards. Another concern with use of facilities is safety. Both equipment and facilities must be strong and placed at the right places to maximise the safety of players as they freely move on the court. In African countries, provision of the right equipment is still a critical problem. There is also little guarantee of the quality and safety of the existing facilities in most of the sports arenas. The quality and accuracy of performance assessment becomes more reliable when proper facilities and equipment are used (Strand & Wilson, 1993).

Diet

An elite athlete requires both quality and quantity of diet before, during and after training and competitions to maximise and maintain performance (McClaren, 1999). With increased professionalisation of sport, nutrition has become recognised as an important issue. In fact, some nutrients are being misused in sports performance. Previous studies on the effects of different types of nutrients on sport performance have indeed helped professional recommendations of the right diet to the athletes and their coaches (Burke, 1997; Dennis et al. 1997; Hawley et al. 1997; Munghan, Greenhaff, Leiper, Ball & Lambert, 1997; Shephard, 1999; Galloway & Munghan, 2000).

Injuries and Health status

Injuries and other health problems can produce setbacks to the performance and retention of motor expertise among expert players. Several causes of injuries ranging from physical to emotional stress have been reported (Ford, Eklund & Gordon 2000). Specifically, athletic injuries have been reported to be induced by social life stress events, lack of social support, perceptual changes and changes in reaction time during practice and competitive environments and dominance of eccentric movements (Donneley, 1999). Shephard (1999) presented a detailed study recommending strategies for controlling the incidence and prevention of injuries and health problems. Those of specific interest in basketball included:

- Strength training of the specific muscles and joints.
- Avoiding over training.
- Getting enough rest and enough sleep,
- Using protective equipment on the ankles and knees.
- Wearing special shoes that are technically recommended in relation to the type of foot and body weight.

Summary

Expertise in sports is more learned than inherited. However, there are some mediating factors that are genetic constraints, including height, lung capacity and body composition (Keul, Konig, Huonker, Halle, Wolfahrt & Berg, 1998; Singer & Janelle, 1999). In some sports, these mediating factors are more important than others. In all sports, expertise can only be achieved if organised training and guidance are provided (Ericsson & Charness, 1994; Ericsson, Krampe & Tesch-Romer, 1993). Different abilities and skills related to the perceptual, cognitive and motor components must be developed over many years of consistent preparation and competitions. Although it is beyond the scope of this study, French & Nevett, (1993), French & McPherson, (1999), McPherson, (1994), French & Thomas, (1987) presented detailed processes of expert development from junior to senior expertise in different sports.

Chapter Six

Methodology

Different investigative approaches have been taken to the study of expertise in sports:

- The *individual differences approach* attempts to map predictable abilities in sport performance. This approach was imported from psychological studies and improvised to fit the perceptual and motor expertise research (Wrisberg, 1993). Several sports studies including basketball (Starkes, Allard, Lindley & Reilly, 1994; Kioumortzoglou et al. 1998; Hoare, 2000), volleyball (Kioumortzoglou et al. 1998c; 1999; 2000), water polo (Kioumortzoglou et al. 1997), tennis (French et al. 1996) have reported that there are specific abilities that appear to be the "underlying components" of athletic development and success in sports. Test batteries have been developed that specify those abilities that have significant correlations to the development of performance expertise in given sports.

  The problem with the abilities approach is that the human being is endowed with so many abilities that research has not been able to exhaust all abilities related to sport performance. Based on this line of reasoning one never knows which individual abilities are influencing the development of performance of the athlete over several years of being engaged in practice and training. The question of how these abilities are combined and transformed into specific adaptations is also important. It is also a difficult approach to use when looking exclusively at top-level performers, since the abilities that are critical at the beginner and intermediate levels of performance may not be the same abilities that are critical for expert level performance.

- The *information processing approach* has also been imported from the psychological study of expertise. Reaction time experiments have been said to record the stimulus identification, perceptual activation processes, response selection and activation of the decision-making processes (Wrisberg, 1993). The

conclusion was that expert players are effective and efficient in information processing that is related to the perceptual processes, effector processes and decision-making processes for specific tasks. However, there are strong arguments from the ecological theory that the "capacity" for information processing of an athlete is field dependent, and not an intrinsic ability of the individual.

- *The expert-novice approach* is based on comparative studies of perceptual skills, recall and memory retention characteristics of expert players and novices (Wrisberg, 1993). It has generally been reported that skilled athletes are better than novices in efficiency and effective in retrieval of game information due to the development of special visual search strategies (Allard, Graham & Paarsalu, 1980; Starkes, 1993; Wrisberg, 1993). Such experiments were organized to measure individual players and not a team or the relation of the individual players to the team. Based on what has been reported so far, it appears that expert players seem to have developed a flexible adaptation of knowing what to do and doing it. From the practical point of view, this forms an important linkage to the study of the nature of top-level performers in team sports.

While previous research approaches have made significant contribution to the body of knowledge of sport expertise, their views must be treated with caution. While in total agreement with Wrisberg (1993), the parallels between observations originating from controlled experimental studies to those of athletes performing in their natural environment may not be fully accommodated. The influence of the team-mates, on the ball and away from the ball is important. On the other side, the opposition has a major role in influencing the kind of decisions taken and the levels of performance. These situations form the main component of the performing environment and it is important that studies in sport expertise should be organized in the natural environmental to capture the real nature of athletic expertise.

The current study adopted a variation of the expert-novice approach, in that it is focused on the identification of the perceptual-motor characteristics of top-level basketball players. No attempt was made to identify the characteristics of performers at any other levels of expertise. Basketball could be taken as a representative case for a large group of invasion team sports, including soccer, rugby, netball, football, handball, field hockey, ice

hockey, etc. One of the main characteristics of these sports is that performance is both individual and collective (within a team). Players do not perform as individuals but as part of the team network of communication and sharing of roles. Another characteristic is that performance is dominated by great uncertainty of the movements of the individual players with the ball or away from the ball

The Qualitative Method

Researchers agree that the qualitative method of inquiry is appropriate when studying unique situations or individuals (McCracken, 1988; Marshall & Rossman, 1989; Creswell, 1994; Kumar, 1996; Marshall & Rossman 1999). The weakness of the qualitative method are that the researcher can be influenced by the situations and perceive the events differently, has influence of cultural differences in data interpretation, effect of ethical issues, difficult to replicate, dependent of the ability of the researcher in being resourceful and honest. While previous studies used the bottom-top approach to describe the nature and nurture of sport expertise (Bloom, 1985; Ericsson & Charness, 1994; Ericsson, 2001), the approach has not been robust enough to unveil the complex nature of top-level athletic performance prevailing in team sports. In an effort to find the missing link of the whole realm of sport expertise in team sports, the current study adopted a top-bottom approach. It is hypothesized that identifying the performance qualities possessed by top-level or elite athletes to have a significant contribution to the body of related knowledge that may be applied in teaching/coaching and for future studies.

Adopting the Qualitative Method

Previous studies trace qualitative research paradigm to be originally established and used in cultural anthropology, sociology and recently in educational research The objective of the study was to get the views of the expert coaches on what identified top-level players from rest of the expert basketball players in team sports. The review of literature reports four commonly used methods in quantitative and qualitative approaches to descriptive research (Patton, 1986; Kumar, 1996; Marshall & Rossman, 1989; Marshall & Rossman 2000; Silverman, 2000). Table 3 presents a summary of these methods.

Table 3. Quantitative and Qualitative Methods of Descriptive Research.

Method	Quantitative Research	Qualitative Research
Observation	Preliminary work leading to forming questionnaire	Fundamental in understanding other sub-cultures
Document analysis	Content analysis mainly counting different categories of choices of researcher	Deployed to understand the different categories of respondents
Interviews	Survey research where specific questions are used to random samples	Open-ended questions for small sample seeking in-depth of their views
Interviews (Transcripts)	Used to check the accuracy of interview records	Deployed to understand the detail the informant's views.

The selection of which method to use is based on the purpose of the particular research project and an understanding of the advantages and limitations of each of the methods. In relation to this study:

- The *observation method* would not give detailed account of the team performance in respect to the top-level performers. During live games, we think we are observing what is to be observed but we are in fact looking. The thrilled movements of the basketball players make the observer get carried away. This method was not practical within the ambit of this study.

- *Statistical (document) analysis* is commonly used to evaluate the performance of the team after a given game tournament. This method is based on interpretation of numbers scored by the computer, the coach or one of the assistants. Numbers are not subjective but more objective. The interpretation is based upon the coach who witnessed the game and would therefore give comments in relation to what was seen. The interpretation would therefore be biased and limited to what was witnessed. To someone who did not see the game, the numbers will give limited information. This method did not seem to be directly applicable to the current study.

- *Interviews, observation, document analysis and transcripts analysis*. Although this approach is very useful, there is a risk to the validity and reliability of the

studies (Silverman, 2000). The *interview method* viewed from the qualitative perspective demonstrated the best potential for soliciting relevant information for this investigation. *Transcripts* of interviews allow careful analysis of data gathered from individuals. It was therefore selected as the primary research method for collecting data in this study. Specifically the long interview – also called the in-depth interview - was used (McCracken, 1988). Based on the description of its utility, a small sample of informants that volunteer to give detailed views based on open-ended questions was used (McCracken, 1988; Marshall & Rossman, 1999).

The Long Interview

The long interview has been credited as a powerful instrument. The questions are structured to gather in-depth information as the researcher probes the mind of the informant(s) to understand the different levels of conceptualizations and perceptions of the issue at hand (McCracken, 1988; Creswell, 1994). The method creates direct interaction of the researcher's intuition about the subject with the minds of the informants to capture meaning.

The Researcher's Role

Within the context of qualitative research, the researcher is actually the primary instrument for data collection. It is always expected that the contribution of the investigator to the field study to be useful and positive rather than destructive (Patton, 1986). The researcher in this study personally conducted the interviews. With that in mind, it is important to disclose my personal background in sport.

My perceptions and practical orientations have been nurtured from many roles of sport involvement over many years:

- **As an administrator:** Coordinator of sports (Sports Officer) programs in the Ministry of Sports and Culture in Tanzania – 1996-1983. Within the period, I worked as a Sports Officer in Dodoma, Morogoro, Kilimanjaro and the Ministry headquarters. As a Assistant lecturer in the Department of Physical Education, Sport and Culture-University of Dar Es salaam, I was acting head of department, 1998 –1999.

- **As a coach:** at the University of Dar Es Salaam- Tanzania, I coached competitive team sports mainly basketball, volleyball and handball in the 1984-1992 period. While studying in Norway 1992-1996, I was assistant coach of the Norwegian Youth basketball team in 1995/66 that participated in the Scandinavian National basketball Championship. Within the same period, I was part-time coaching different youth basketball clubs (12-17 years) in Oslo city, Norway.

- **As a Teacher:** I was responsible for the organization and teaching of sports in Kondoa District Primary Schools- Dodoma region, 1974-1996. As lecturer of sports science in the department of Physical Education, Sport and Culture (PESC)- University of Dar Es Salaam (UDSM), from 1996 –1999. I offered basketball, volleyball, handball, netball and tennis practical courses. Besides the practical courses, I helped the fourth year students to complete their final projects. The projects are mostly field related studies that required guidance in selection of the proper basic research methods and application. While working for my thesis at Stellenbosch University (2000-2002), I had an opportunity to teach practical courses- mainly basketball and volleyball in the Department of Sport Science.

Objectivity and Subjectivity

The long interview method is not intended to be objective. It is subjective with the intention of gathering the views of the informants on a specific topic with which they have personal experience. This does not release the data collection and interpretation processes from the need to be valid, however. The method was selected because it has the potential of bringing the researcher closer to the minds of the informants.

Based on the previously advanced qualitative assumptions (Creswell, 1994), the meaning of what was to be investigated and the approach is important in interview methods. In view of the above, validity of the collected data was maintained through internal validity, a process called consensual validation and external validity.

- *Internal Validity* was established through intellectual rigor. Several visits to the data were made by the author to see if the themes, explanations and interpretations reflected the nature of top-level athletic performance in team sports.

- *Consensual validation* was the process though with two trained researchers worked to categorize the units of meaning drawn from the transcripts into themes, higher order themes and categories of meaning. Each researcher worked first to complete his/her independent analysis of the data. Then, the two analyses were compared and where discrepancies existed, a discussion/negotiation took place to ensure an agreement on how each unit of meaning should be categorized.

- *External validity* was tested through a comparison of the collected coaches' views. Their views were compared to what has been reported by other research studies (literature review) in related areas in order to identify consistency of agreement and points of difference.

Ethical Considerations

Qualitative research has the character of enhancing close interaction situations between the researcher and the informants (Creswell, 1994; Marshall & Rossman, 1999; Silverman, 2000). With regard to the structured intensive questioning of the current study, the need for respecting, protecting the rights, needs, values and desires of the informants was observed. The following measures were taken:

- Verbal explanation of the research objectives was given so as to clear the minds of the informants.

- Informants completed and signed the interview agreement form. Consent to conduct the interview also was requested from each one.

- Informed the informants that the interview was to be recorded on a tape recorder for later review.

- Informants were told that if interested, the results of their interview could be posted back to them at the end of the study.

Procedures

The following procedures were followed in this study.

Development of the Interview Protocol

According to the nature of the current study environment, the in-depth or long interview was adopted to solicit the relevant data. The method provides freedom for the informants to express their personal views in a deep way. According to Patton (1986), the merit of a structured interview is that the informant is given a clear idea of on what to respond and in what depth a response is sought. In this method, time and focus of attention may be managed. Although structured, the interview questions were not aimed at getting the same replies from the informants. Individual differences are encouraged in the course of challenging intellectual abilities and personal experiences of the informants.

An important characteristic of the long interview is that it maintains a strict focus on pre-set questions during the course of the interview (Patton, 1986). The full list of the interview questions used in the long interview can be seen in Appendix A. The planned questions were open-ended and specifically designed to probe the knowledge of the experts interviewed. The planned format of the questions consisted of the following:

- *Open questions* to enable informants to express their views.
- *Closed questions* to direct the informants to provide specific answers.

The questions were phrased in such a way that the informants were encouraged to explore their own thoughts and insights into expertise in basketball. These type of questions included:

- *Could questions,* to get the general view or summary of the conversation.
- *What questions,* to elicit facts and information.
- *How questions,* to enable informants to express deep feelings of the situations.
- *Why questions,* used to establish basic reasons for the different issues.

- *What else questions,* which were used to enrich the conversation if the informant missed one point and thought important to be mentioned.

During the interview, if the informant mentioned a point or made a statement that was difficult to understand in relation to top-level performance, the interviewer took a proactive position and different types of planned "prompt" questions were prepared. These were as follows:

- *Contrast questions* that were restricted to what had already been reported by the informant were used. Upon exhaustion, terms related to the literature and cultural views were introduced. Only when the expected information did not come out of the informants mind did the contrast probing come in.

- *Category questions* formed part of the planned prompt questions. The investigator was keen to see that all questions under the discussion topic were answered through a checking method.

- *Recall questions* were used in some aspects of the interview to create more interest and capture some of the concealed ideas. Informants were asked to recall exceptional game situations and tell how they managed to cope with the different situations. This planned obtrusive prompting was used in situations where the informant appeared having difficulty in expressing his/her ideas.

- *Surprise questions* were prepared to seek other forms of knowledge that was not extracted from the previous techniques. For example, "Some people say that professional basketball players do not learn anything from participating in the Olympic games as representatives of their countries. What do you think?"

- *Hypothetical questions* were formulated. For example, "Lets suppose that you are selected to prepare a team of elite basketball players from Africa to play against the elite USA basketball players for a prestigious Mandela trophy. What criteria would you use to screen the best players from different countries of Africa?" Such questions were aimed at digging deep into the mind of the informant.

Field Test of the Interview

Before embarking in the field research work, the content and structure of the interview questions were tested for practicality and clarity. To determine the correct amount of time spent i.e. at least not more than three hours and not less than one hour of rigorous interviewing, the usefulness of the interview questions was tested through a structured interview administered to a small group of University basketball coaches. A similar procedure to be used in the actual interview was followed. The coaches were invited to assist in the re-phrasing of questions, as well as encouraged to suggest additional questions and probes.

Identification of a Second Research Expert

A second researcher with expertise in basketball was recruited for the data collection and data analysis phase of this study. This individual has coached basketball at the top-level in the United States and has participated as a player on a Basketball National Championship Team, also in the United States. This individual was first consulted about the interview questions in order to check for complete coverage of the topic. Later, during the data analysis phase of this study, this researcher provided the input for consensual validation of the process of identifying units of meaning, as well as grouping those units into themes, higher-order themes, and finally categories of meaning.

Identification of the Informants

It is now important to say something about the nature of the informants in relation to the objective of the study. Expert coaches were identified as a group who has unique and in-depth insight into the development of expertise in basketball. Coaches spend more time with their players than parents do in a basketball competition season. They are dedicated in helping them to develop the necessary performance qualities over many years of hard work. Although it is an indirect approach, it is the author's conviction that the views of expert coaches are important in mapping the performance nature of the top-level or elite players. These views are to be described in a detailed way based on the coaches' experiences gained from working with different players. The long interview was selected to capture the scenes behind the exceptional performance of elite basketball players.

Conducting the Long Interview

Data collection started in April through May 2001. A series of interview appointments were made prior to the interviews though phone calls and e-mail correspondences. The author administered all interviews personally. An average of one-hour in-depth personal interview was carried out with each informant.

Selection of the Informants

Previous studies in, long interviews recommend using only a few informants (McCracken, 1988) who are able to give detailed account of their knowledge in a specific area. The current study recruited six coaches for the in-depth interview. Only coaches who were active and had been coaching at the top-level in the last five years (minimum) were recruited. They were those who had been successful within their career. Being successful is determined by the number of wins against loses of the teams they have been coaching. Similarly, as a result of their performance, some of them have been selected to manage the national teams or professional leagues. The informants were from different cultural background, values and experiences of the game of basketball. The recruitment of the coaches was broad in the sense that they represented the major continents of famous basketball activity. They originated from Europe, USA and Africa. It is expected that their views would paint a true color of the nature of top-level athletic performance.

Place of the Interviews

All interviews were conducted in quiet and comfortable places, either in an office or residence. Receiving phone calls was not allowed. Cell phones were switched off and visitors were not allowed in for the entire period.

Procedure during the Interviews

Interview information must be a true and accurate representation of what the informant has said. It is therefore important that measures are taken to see that every detail is properly recorded (Patton, 1986). In this study, a complete audiotape was made of each interview, and a professional secretary made a verbatim transcription.

- *Before the interview*: A quiet place free from interruptions was used and the table and chairs were placed close to the electric main supply for power supply to the

tape recorder. The tape recorder was rechecked to assess its functional capacity once connected to the mains for power supply. The tapes were replayed back and forward to recheck the full function. There were extra tapes available should any develop mechanical problems. The tape recorder was placed on a flat table close to the interviewer as well to the researcher to pick-up clearly all of the questions and answers. A two-minute recording test was done before the interview. The casual conversation between the informant and the researcher (use for "loosening up") was recorded and a replay was done to listen and confirm that the tape was running well. The tape was then re-set and the informant was told that the actual interview was about to begin.

- *During the interview*: The beginning of the interview was very important. The informant was asked to speak clearly and slowly so that recording could be clear. Shorter more factual questions were asked at the beginning of the interview. Then, as the informant relaxed, the more complex questions were asked. Probes and prompts were used as necessary. Some informants were able to talk a lot to the extent that responses of the prompt questions were unnecessary. To decide whether a prompt question was to be raised or not required listening skills and understanding the content of the given information.

  The researcher performed "active listening" and faced the informant. This was to give the informant the impression that the interview was important and therefore demanding the informant's attention during the whole conversation period. Prompt questioning was immediate and if a question was not clear, a short explanation of the detailed question was given so as to make the content of the question clear.

  After half an hour, the interview would be stopped for two minutes to play back the tape and recheck the recording quality. Re-checking was done twice in every interview session. At the end of the interview, the informant was thanked for volunteering to give his views. A contact address was requested for further correspondence.

- *After the interview:* Back in the laboratory, the each recorded interview was replayed in full to listen to the interview. Each tape was labeled and stored in a

container in a cool and secure place. Contact was made with the professional secretary responsible for making the verbatim transcriptions of the tapes. The tapes were transferred to her office, where she completed the production of the full scripts of each interview.

Data Analysis

The method of content analysis used in this study also was used by Scanlan, Stein and Ravizza (1989) in their in-depth study of sources of enjoyment of former elite figure skaters. The method was also used again in their complementary study of the sources of stress of former elite figure skaters (Scanlan, Stein & Ravizza, 1991). The method is labelled "Inductive Content Analysis." The purpose of the method is to draw "meanings" from the emerging quotes from an in-depth interview. This is done through a process of consensual validation, based on a sequence of steps

Step 1: Unit of Analysis

The verbatim transcripts were reviewed individually and individual "quotations" of sufficient length to have meaning, were identified as the primary units of analysis for this study. All quotations were included in the data reduction process

Step 2: The Process of Data Reduction

The two trained researchers with special knowledge of top-level basketball independently identified and selected the quotes after reading and rereading the verbatim text. Their next task was to work independently and group the quotes into clusters of related meanings. These clusters were later labelled as lower-order themes. Quotes that were off the topic or not specific enough to cluster were categorised as Special Comments. These researchers then met together to examine their clustering of quotations. When there were discrepancies, negotiations were held to determine how to deal with the quotation. In all cases, it was necessary for both researchers to agree on the final cluster for each quote. A similar process of negotiation was followed to find an appropriate label for each of the clusters (lower-order themes). This initial classification of units of meaning is presented in Appendix B.

The next level of data reduction was to establish more general or higher-order themes. The same process of consensual validation was followed. The final level of data reduction was to group the themes into categories of meaning. The criteria of formulating the categories were based on the overarching character of the themes.

The special Comment Class themes were debated jointly about their overarching representation and meanings. Finally, it was agreed to split them into relevant themes to determine their level of representation. Upon completion of the exercise, it was found that they were broadly representative of the rest of the themes.

Consensual validation has potential in eliminating analyst bias. In view of the current analytical approach, the identified quotes, themes and categories are more accurate representations of the coaches' experiences about the qualities of top-level basketball performers. Organization of the recorded data into themes, categories and descriptive units is what forms the analysis process.. The organization of the data in proper perspective enhances the exercise of analyzing the content (Patton, 1986; Lock, 1989; Marshall & Rossman, 1989; Schutz, 1989; Siedentop, 1989; Kumar, 1996).

Summary

Interviews with expert basketball coaches were conducted in order to gain insight into the characteristics of top-level basketball players. During the analysis of the content of those interviews, a consensual validation technique was used to cluster quotes into different groups of meanings from which different themes and categories of overarching meanings were established. Consensual validation is a mutual agreement criterion of formulating accurate quotes, themes and categories (Patton. 1986). The results of the analysis are presented in the following chapter.

Chapter Seven

Results, Discussion and Conclusions

The current study was aimed at identifying the perceptual-motor characteristics of top-level basketball performers. The study to identify these characteristics began with a review of current research on the topic. Then, in order to gain insight about expertise from the natural environment of performance, six expert basketball coaches were interviewed. The interview method has been used in previous studies related to expertise in sports (Thomas & Thomas, 1999; Starkes, 2000; Chisholm, 2001; Hyllegard, Radlo, Early, 2001). Based on inductive analysis of the coaches' comments (see Appendix A), the meanings attached to the quotes were organised into themes, the themes were consolidated into Higher Order Themes, and the Higher Order Themes were combined into Categories. Eight categories of meaning were revealed from the interviews:

1. Motor Performance.
2. Decision-making.
3. Performance opportunities.
4. Group membership.
5. Physical dimensions.
6. Attitude.
7. Psychological characteristics.
8. Background of the player.

The results of the inductive analysis of the interview data are presented in Figures 6, 7, 8 and 9.

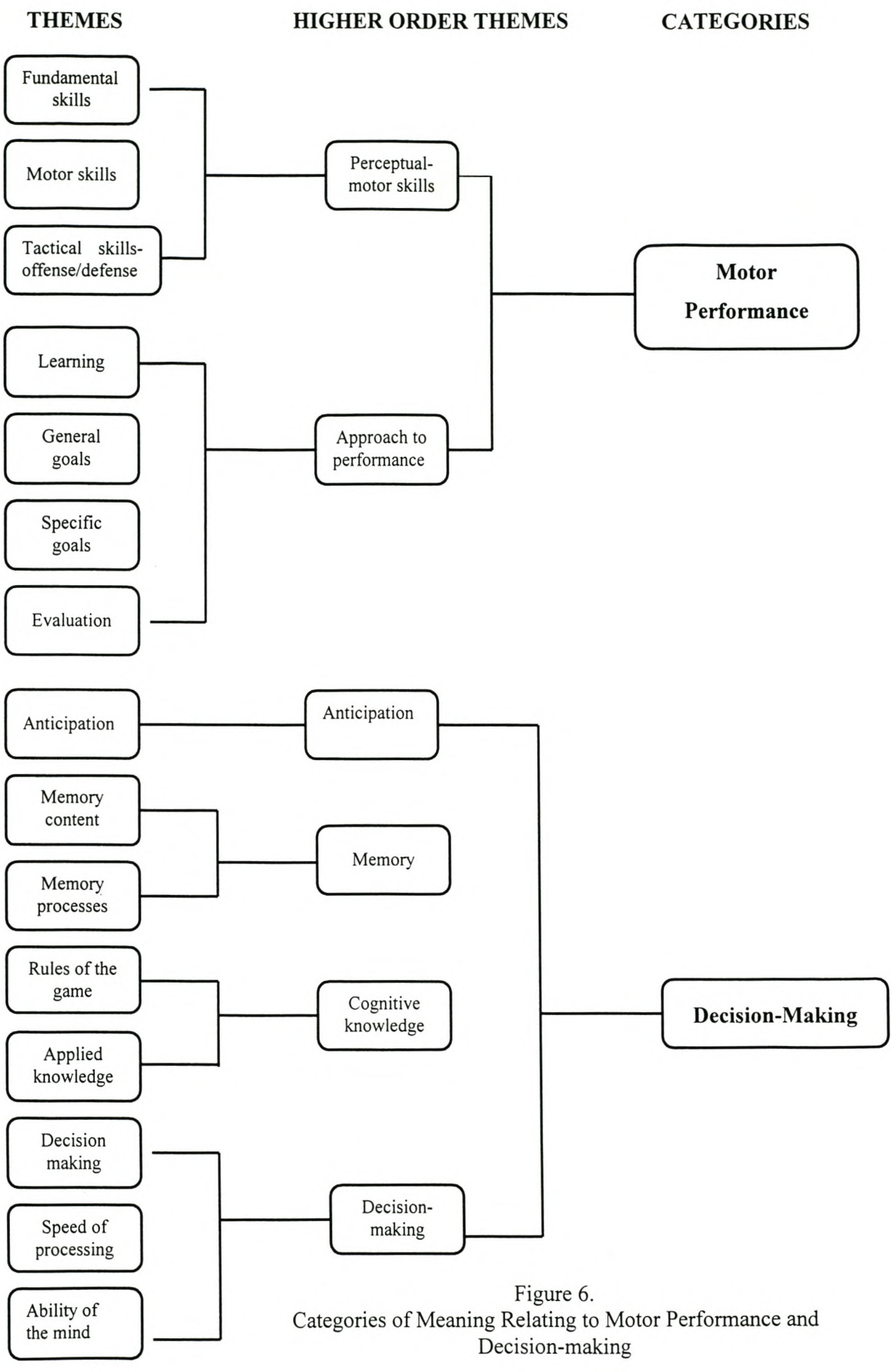

Figure 6.
Categories of Meaning Relating to Motor Performance and Decision-making

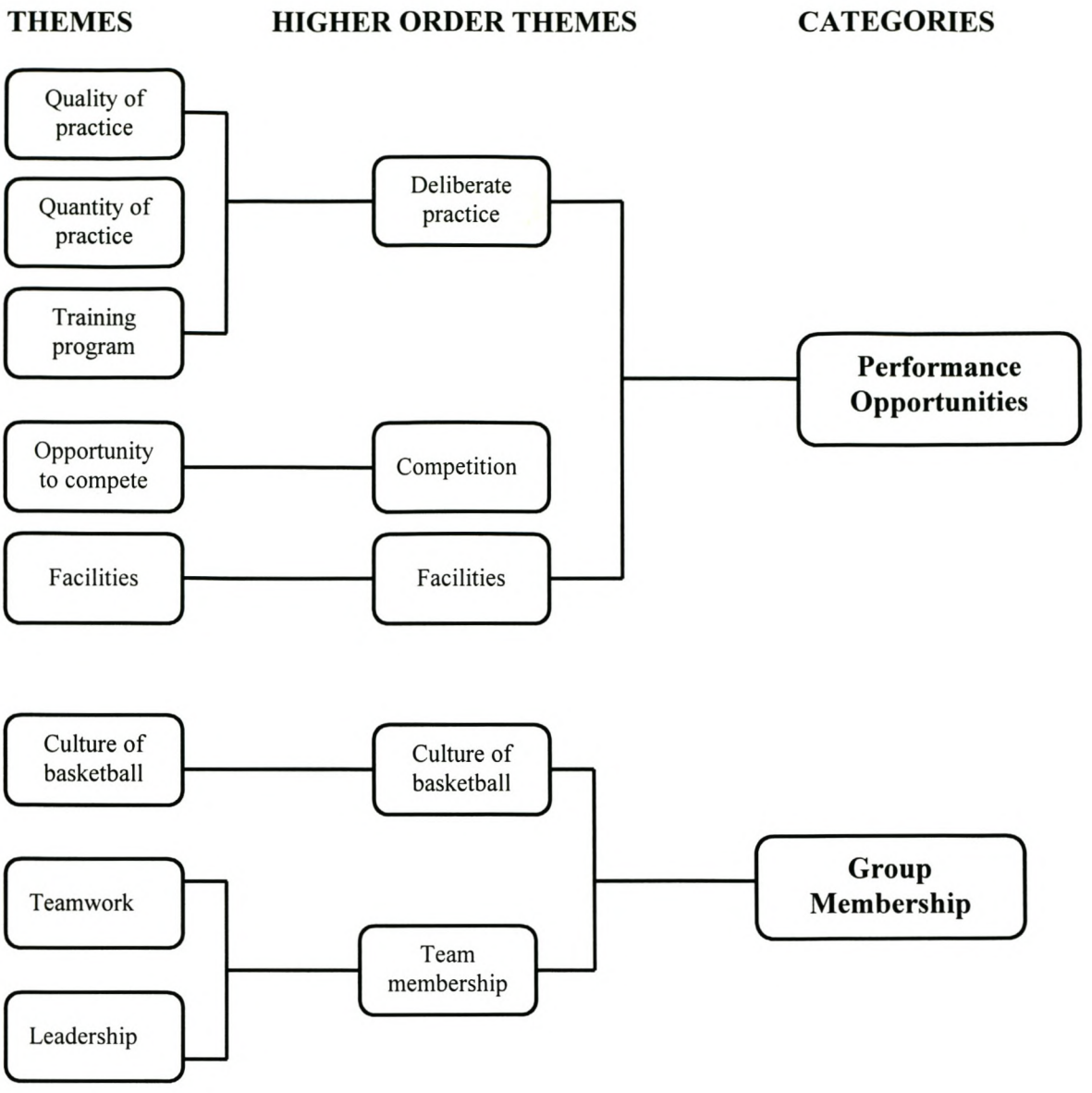

Figure 7.

Categories of Meaning Relating to
Performance Opportunities and Group Membership

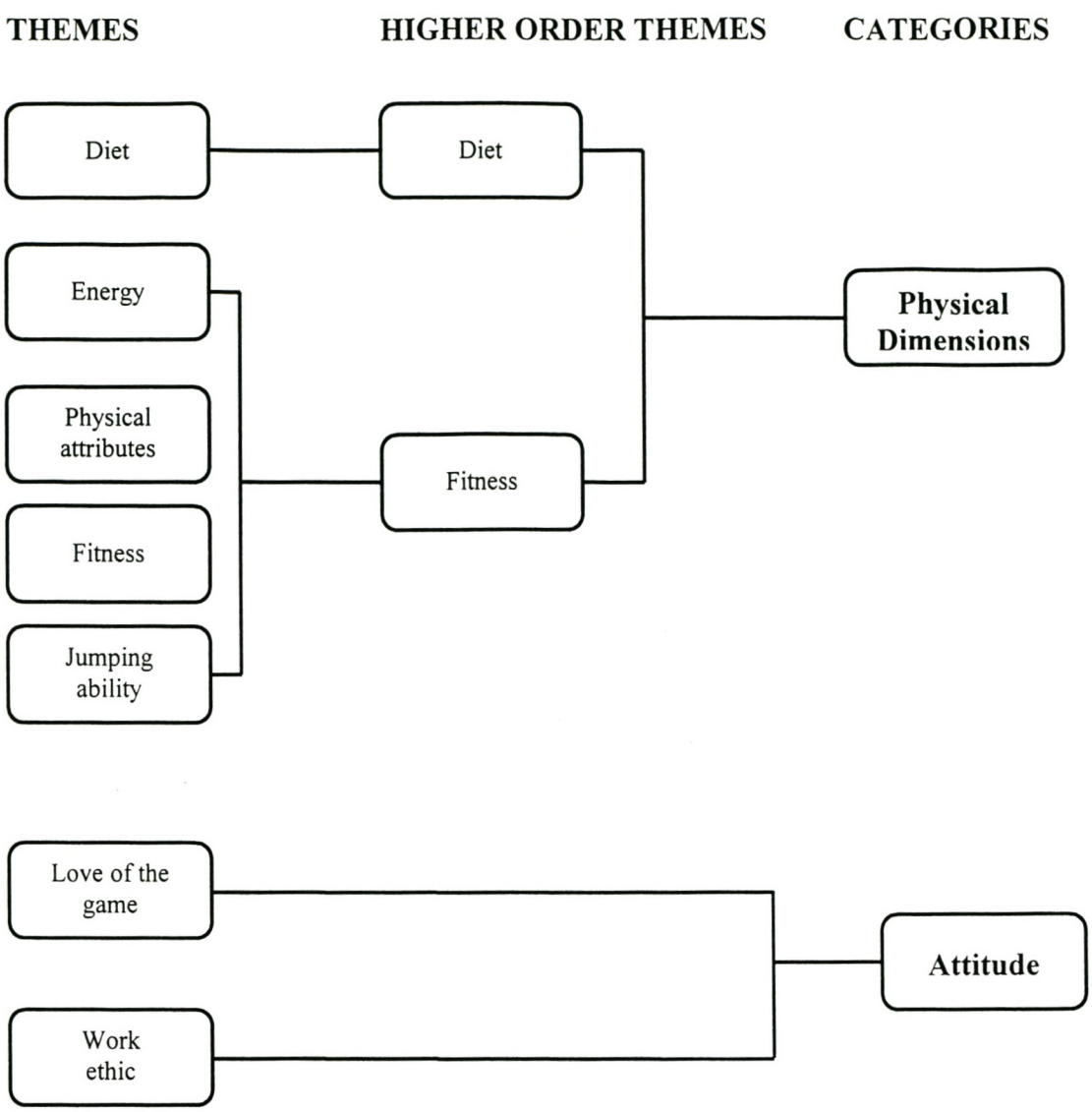

Figure 8.

Categories of Meaning Relating to Physical Dimensions and Attitude

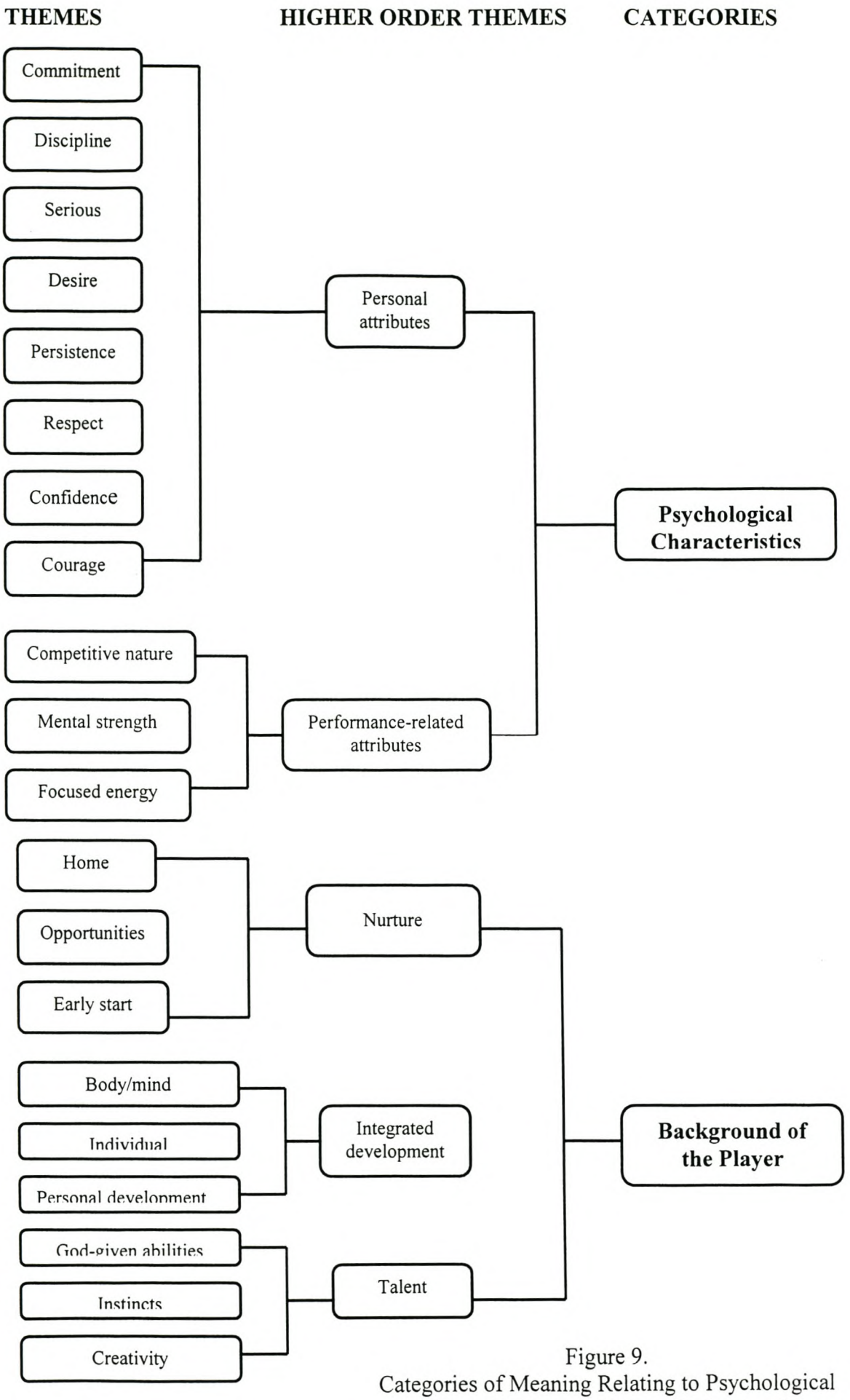

Figure 9.
Categories of Meaning Relating to Psychological Characteristics and Player Background

Research Question One

Are there any aspects of the process of perception that characterize top-level basketball players according to expert coaches?

Although visual software skills have been described as important in sport expertise (Williams, 2000; Abernethy & Wood, 2001) no perceptual skills were mentioned specifically by the expert coaches as characterizing top-level players.

One can only speculate about this apparent discrepancy between what the research has found and the lack of mention by the expert coaches. The following variables of visual perception were identified in the literature about basketball:

- Visual memory.
- Speed of visual search.
- Peripheral vision.
- Visual anticipation.
- It was also noted that the requirements for visual perception would change according to the position played as well as the players' positions on the court.

Perhaps the coaches lack an understanding of perceptual skills and are not aware of the role of perception in performance. Perhaps they do not know that many perceptual skills – including visual skills – are central to decision-making, and that they can be improved though practice.

On the other hand, they may be fully aware of the role of perception in motor performance, but do not consider perceptual skills to be distinguishing characteristics of a top-level player. It is possible that they see perception, including visual perception, as something that is mastered at an earlier stage in the learning process. What is challenging about this view is that there are sport scientists who are working out perceptual training programs, including proprioceptive training and sports vision training, as a means for improving the performance of top-level teams (Abernethy & Wood, 2000; Williams, 2000). This should be considered as pioneer initiative by the sport scientists to document

the kind and value of perceptual training programs for top-level performers. However more input is needed in the point of view that visual perceptual skills vary with sports as well as among athletes. This is the basis of the logic of the training programs.

Research Question Two

Are there any aspects of the decision-making process that characterize top-level basketball players according to expert coaches?

The expert coaches identified decision-making as a defining characteristic of top-level basketball players. It emerged as an entire category of meaning, with the following aspects identified as higher order themes:

- Anticipation
- Memory, including memory content and memory processes.
- Cognitive knowledge, including rules of the game and applied knowledge.
- Decision-making, including decision-making processes, speed of information processing, and ability of the mind.

The level of agreement among the coaches (although they were interviewed independently) is presented in Table 4. In this table, it is noted which coaches mentioned which themes of meaning during their interview.

Table 4. Level of Agreement among Experts about Themes relating to Decision-making.

		Expert Informant						
Higher Order Theme	**Theme**	**N**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Cognitive Knowledge	Memory – Process	6	Yes	Yes	Yes	Yes	Yes	Yes
	Rules of the game	2		Yes	Yes			
	Applied Knowledge	4		Yes	Yes		Yes	Yes
Decision-Making	Decision- Making	5		Yes	Yes	Yes	Yes	Yes
	Speed of Processing	6	Yes	Yes	Yes	Yes	Yes	Yes
	Ability of the Mind	4	Yes	Yes	Yes	Yes		

Decision-Making was defined as the demonstrated capacity of basketball intelligence. It is a process that involves the ability of the mind to integrate the externally originating information with related information from the memory. In the literature review, decision-making was conceptualized as central to sport expertise and important for performance attainment. Efficient and accurate decision-making is acquired through deliberate practice programs related to sport expertise (Ericsson & Charness, 1994).

When asked about the performance qualities of top-level basketball players, expert coaches described them as "good in decision–making". Further, they explained that decision-making of top-level basketball players to be influenced by "...many things happening very quickly," "... they have the ability to think quicker than others," "... the quicker you can make decisions, respond or react the better," "...they are able to process information in their brain faster," "… they think within the speed of the game," and "... they learn how to think rapidly." These observations emphasize the overarching quality of decision-making of top-level basketball players. With regard to the speed of the game, elite players are adapted to think and correctly execute their decisions within the tempo. The complexity of the decision-making ability is when elite players have to carry out decisions that are coordinated with decisions of fellow players. Although it appears complex to the outsider, top-level players have adapted to such an extent that for them it is simple and smooth game. Even if the opposition counteracts, there other immediate options in reserve so that they are not easily beaten. One of the expert coaches overwhelmingly commented that "modern basketball is like the chess game." There is a lot of thinking and rethinking for better solutions all the time because both teams play with a lot of intelligence.

Based on the data analysis, the following processes support the superior quality of decision-making that characterize top-level basketball players:

- **Anticipation:** Expert coaches described basketball as a game of reactions. According to them, the superiority of top-level players was in part their ability to anticipate well. Anticipation was attributed to the capacity to "... visualize situations, "...be a step ahead," "...know how the players are going to move," and "...react on signs (they) know."

They were described as always a step ahead in predicting where the next pass is going to be. Their ability to read the movements patterns of the opposition is based on previous experiences related to the game. As such, they are bale to adjust correctly and react in time.

One expert coach confidently described that top-level basketball players see the opposition in a three dimensional perspective. " *They see them off the ball, on the ball and as a team configuration on the court"*. Based on these situations, they are able to read the possible options they will take prior to playing the ball to one another or shooting. Although this coach may not have been aware of it, he was actually referring to the visual anticipation strategies for timely decision-making and reacting.

- **Memory:** In the context of expert performance, memory based is part of the memory content and the memory processes.

  Memory content is linked to the quality of the knowledge base. French and McPherson (1999) defined:

  > "The knowledge base for sport to include all the traditional prepositional networks for conceptual knowledge (i.e. both tactical and skill related) and procedures for response selection and execution. In addition it includes specific sport memory adaptations and structures (p. 179).

  Memory processes include "...thinking that develops into reactions through years of experience." Definitely, the volume of practice has influence to the quality of the developed memory. According to their comments, "...it is just a bunch of replays, ...seeing the different scenarios over and over again, ...practice through repetitions." This displays emphatic evidence that the secret of improvement in memory output to be through increased volume of functional repetitions taken over extended practice sessions for many years.

  Although difficult to understand how the human brain works, expert coaches tried to explain the memory characteristics of top-level basketball players. On how it works, they reported as, ... decisions based on something that has not been successful in the past, ...in a game, your mind immediately goes back, ...On the volume of memory, they understood it as "...the more you play,

the more memory you have, ...memory improves through the number of repetitions. In general, the expertise of top-level basketball players was conceived as "...complex way of utilizing the memory, ...they are at their highest performance when they are not thinking, ... there is not a new situation that needs to think about, ...the more you know the easier it is going to be to react." In order to rise above the rest of the expert performers, the performance of top-level players is influenced by the huge amount of experiences gained from several years of practicing and competing. One of the expert coaches put it "*I would say most of them don't think but their instincts are so incredible that they do things that others think they did not think*" The statement supported the capacity of the athletic memory with a large volume of related chunked patterns of the game from which every action has a strong reference and therefore part of the player's way of coordinated movements happening in a natural way with less thinking.

Contextually, there is a linear relationship between the memory output and motor skills of the athlete. The quality of the memory output influences the timely reactions of motor skills to such an extent that a top-level basketball player appears to be performing more instinctively with less effort.

- **Cognitive Knowledge:** For the expert coaches in this study, cognitive knowledge referred to two different "clusters of meaning" or themes.

Knowledge of the rules of the game was identified as having a significant impact on achievement in basketball. According to these coaches, top-level basketball players not only know the rules, but they also have the capacity to utilize the rules of the game to their advantage as well as their team's advantage. As described by expert coaches, they are able to "...force them (their opponents) to play faster" and to "...influence huge changes in the game set-up."

Applied Knowledge related to practical knowledge was defined as the ability to integrate knowledge from the memory and to derive knowledge originating from the environment specific to the task requirement of the game. In the literature review, expert players have been described as having higher knowledge ability (Thomas et al. 1986). The experiential knowledge referring to the amount of accumulated knowledge has been recognized to be one of the main characteristics

of expert players in team sports. The different game situations occurring during a given competition are not new to them but the opposing players are new. They are therefore able to apply their experiences to anticipate the structure of the movements of the opposition players and quickly adapt to the situation.

In view of the views of expert coaches, the experiential knowledge, i.e. practical knowledge, of top-level players has considerable influence on their performance characteristics. One of the coaches went further: "A lot of what they do is reactive because of the gained experience in playing so much." They are experienced in associating the environmental knowledge with what they already know and coordinating their decisions with other players in the team.

Expert coaches attributed the knowledge characteristics of top-level basketball players in three levels of application:

> In the general concept of knowledge application, the top-level player was described as "...knowing what to do," "...wanting to know more," and "...having skill that has been developed alongside understanding".
>
> From the experiential point of view, "... it is application of the knowledge that makes a difference," "... understanding of the game from a team perspective," "... understanding their roles in the game," and "...recognizing that every game is different".
>
> In the intellectual aspect, top-level players were described in this way: "...they are smart players who have learned to read the game," and "... they go into so much detail."

- **Decision-making:** As a higher order theme, decision-making consisted of three themes. In addition to decision-making, the speed of information processing and the ability of the mind were mentioned.

  Speed of processing information was identified by expert coaches as the capacity of top-level players to "...learn things quickly," and "...the ability to be a little quicker than the minds of other players."

Ability of the mind was defined as the mental capacity to perform several complex functions accurately within the speed of the game. The comments substantiated the intellectual capacity of the top-level players in the ability to incorporate different tasks of the game and yet perform accurate and timely decisions. In a study of team assists and win-loss records in the NBA league Melnick (2001), described the ability of the mind in terms of court intelligence as an important ingredient for executing the right pass in a timely way. All in all, intellectual capacity of the top-level player is based on being "game smart." The capacity to think and carry out accurate decisions for the benefit of the team is one of the important aspects of elite experts. During the discussion of the ability of the mind in decision-making, one expert coach commented …"they visualize the situations" much better such that a selection of better option for decision is taken consistently.

In comparing what the coaches said to what was discovered in the literature, there is a close match. According to the summary of the literature, experts were characterized as having:

- Superior cognitive structures and memory.
- The ability to take in large amounts of information and use it effectively.
- Superior recall ability (they can verify information and make accurate decisions quickly).
- The ability to make decisions in complex situations.

The comments by the expert coaches supported this characterization of the top-level basketball player.

Research Question Three

Are there any aspects of motor performance that characterize top-level basketball players according to expert coaches?

Perceptual-motor skills are important in mapping the zone of sport expertise in team sports (Thomas & Thomas, 1994). The comments made by the coaches supported this

view. Table 5 provides the level of agreement among coaches in their description of the motor performance aspects of top-level basketball players, including their approach to performance.

Table 5. Level of Agreement among Experts about Themes relating to Motor Performance.

		Expert Informant						
Higher Order Theme	**Theme**	**N**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Perceptual/ Motor skills	Fundamental Skills	5		Yes	Yes	Yes	Yes	Yes
	Motor Skills	6	Yes	Yes	Yes	Yes	Yes	Yes
	Tactical Skills-offense/defense	6	Yes	Yes	Yes	Yes	Yes	Yes
Approach to Performance	Learning	3			Yes	Yes		Yes
	General goals	2			Yes	Yes		
	Specific Goals	2			Yes		Yes	
	Evaluation	6	Yes	Yes	Yes	Yes	Yes	Yes

The following motor characteristics were reported by the expert coaches as identifying who is a top-level basketball player from the pool of other expert players:

- **Fundamental skills** were identified as a continuing feature of the practice sessions of top-level players. The level of their athletic performance was described as "…more than developing fundamental skills… defense, offence, eye-hand coordination, footwork and ball handling." Regardless of their high level of participation, top-level players find time to practice the basics of the game. However, there is no evidence from previous research that practicing fundamental skills are important in sustaining expert performance in team sports. Research in this aspect of sport expertise will be important in the future.

- **Motor skills** execution was defined as "...like a Ferrari" way of performing a task, with flair and with great efficiency. Top-level players were described as "…having more and a greater degree of skills," "… good balance," and "…a master the skills." While other players have acquired significant levels of motor

skills, a top-level player, according to expert coaches, has an extra percentage that is a cut above the others.

At the high level of competition, all the players are skilled in their game. During practice, they can pass, dribble, and shoot equally well. But if you observe them during a competition, differences in skill levels can be seen. The advanced and less advance performers can be identified.

- **Tactical skills** of the game were defined as how well one adapts quickly to the game changes as well as toward counter playing the changes imposed from the opposition. From the interview responses of the coaches, a top-level player was described as "...one that understands the game in a more scientific way and able to describe it to others." They saw expertise being rooted in the knowledge component. Top-level basketball players were described as "…able to read the situation before others and make the right move," "…using their skills in play effectively," "…making the quick adjustments in the game that make a difference," and "…being able to find extra solution". In *offensive tactics*, top-level basketball players are identified as "…setting motions that allows them to be free," "…know where is the extra screen from the team-mate," "…more trusting to pass the ball," and "…achieving consistence in scoring in every game."

  In *defensive tactics,* top-level basketball players were described as "…being great defensive players," …able to counter everything," "…being consistent in their defensive play," "…disturbing the team plan of the opposition," "…forcing them to make a pull-up jump". The consistency of the top-level players in delivering the defense was said by one coach to make all the difference in the game of basketball. To a great extent, top-level players have extra advantage in the application of their tactical skills.

According to the expert coaches, the tactical skills advantage of top-level basketball players is based on how well the athletes are able to integrate their perceptual skills with the motor skills. This should be seen as specific tactical adaptation of individual athletes to the team sport. As explained by one of the expert coaches …"their ability to raise above all the difficulties, to be able to change and adapt makes a significant difference". Top-

level players are expert in deploying their tactical skills to influence the performance of their team-mates while they are creating problems for the opposition. In the last seconds of the game for example, top-level players would be trusted to handle the ball and dictate suitable movement options. This trust comes from the fact that they are consistent in their game performance and able to find solutions for the immediate critical situation while other players would be desperately frustrated. In terms of the team performance, top-level players are reliable.

In addition to looking at the actual movement expertise of the players, the coaches mentioned a number of features of deliberate practice (including access to proper facilities and the opportunity to compete) and team membership, which they considered central to defining the characteristics of a top-level player (see Table 6). These themes all correspond to what has been reported in the literature on deliberate practice and the contributing factors to sport expertise (Ericsson, 2001). In defending the need for practice, one coach describe, as "It is the competitions In order to compete you have to keep on performing…there is always a new generation coming in with different style and you need to be able to defend that". Although not related to the perceptual-motor characteristics, they all apply to the learning processes that lead to the development of expertise, i.e. quality of practice, quantity of practice and the training program, adopting the culture of basketball and embracing team membership.

Table 6

Level of Agreement among Experts about Themes relating to Performance Opportunities and Group Membership.

		Expert Informants						
Higher Order Theme	**Theme**	**N**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Deliberate Practice	Quality of Practice	4	Yes	Yes	Yes		Yes	
	Quantity of Practice	4		Yes	Yes	Yes	Yes	
	Training Program	3			Yes	Yes	Yes	
Competition	Opportunity to Compete	3		Yes	Yes		Yes	
Facilities	Facilities	2					Yes	Yes
Culture of Basketball	Culture of Basketball	3	Yes	Yes		Yes		
Team Membership	Teamwork	6	Yes	Yes	Yes	Yes	Yes	Yes
	Leadership	5		Yes	Yes	Yes	Yes	Yes

A limited number of physical dimensions and attitudes toward the game were also mentioned in the interviews. Looking after one's diet and fitness appear to be characteristics of a top-level player, as well as loving the game and having a positive work ethic toward basketball (see Table 7). These attributes were also mentioned by Ericsson (2001) as features in the development of expertise.

Table 7

Level of Agreement among Experts about Themes relating to the Physical Dimensions and Attitude.

		Expert Informants						
Higher Order Theme	**Theme**	**N**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Diet	Diet	3	Yes	Yes	s		Yes	
Fitness	Energy	5	Yes	Yes	Yes		Yes	Yes
	Physical Attributes	5		Yes	Yes	Yes	Yes	Yes
	Fitness	6	Yes	Yes	Yes	Yes	Yes	Yes
	Jumping Ability	3	Yes	Yes		Yes		
Love of the Game	Love of the Game	2			Yes			Yes
Work Ethic	Work Ethic	6	Yes	Yes	Yes	Yes	Yes	Yes

"Love of the game and the love of winning" were mentioned by one of the coaches as some of the characteristics of top-level players. Such motives should be considered potential in influencing work ethics such as hard working during both practice and competitions.

Additional Characteristics Identified in the Interviews

A number of variables mentioned in the interviews were not specifically included in the review of literature focused on the perceptual-motor characteristics of top-level players, but are never the less worth reporting here (see Table 8).

Two of the higher order themes, nurture (home, opportunities and early start) and talent, were specifically mentioned by the coaches. Nurture referred specifically to a supporting home environment where the parents in particular made sacrifices to help their child develop expertise. Opportunities to received top teaching and coaches was also highlighted, as was the importance of getting started "as a child" on the road to motor expertise. All these issues were mentioned by Starkes (2000) and Singer & Janelle (1999)

Table 8

Level of Agreement among Experts about Themes relating to the Psychological Characteristics and Background of the Player.

		Expert Informants						
Higher Order Theme	**Theme**	**N**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Personal Attributes	Commitment	3		Yes			Yes	Yes
	Discipline	3	Yes	Yes			Yes	
	Serious	3	Yes	Yes		Yes		
	Desire	4	Yes	Yes			Yes	Yes
	Persistence	2	Yes	Yes				
	Respect	4		Yes		Yes	Yes	Yes
	Confidence	4	Yes	Yes	Yes		Yes	
	Courage	2	Yes	Yes				
Performance-related Attributes	Competitive Nature	4			Yes	Yes	Yes	Yes
	Mental Strength	6	Yes	Yes	Yes	Yes	Yes	Yes
	Focused Energy	5	Yes	Yes	Yes		Yes	Yes
Nurture	Home	2	Yes	Yes				
	Opportunities	6	Yes	Yes	Yes	Yes	Yes	Yes
	Early Start	5	Yes	Yes	Yes	Yes	Yes	
Integrated Development	Body/mind	2	Yes					Yes
	Individual	2	Yes	Yes				
	Personal Development	3		Yes			Yes	Yes
Talent	God-given Abilities	4	Yes	Yes			Yes	Yes
	Instincts	2		Yes			Yes	
	Creativity	1				Yes		

as critical ingredients in the development of expertise. Talent, also mentioned by Starkes (2000), was much more highly rated by the expert coaches than it was by the researchers. Coaches appear to be convinced that practice is not enough, and that there has to be that "special something" present in order for a player to achieve the top-level. One of the expert coaches explained "because you are a top-level player, you have to create opportunities for yourself and for your team mates. So you have to be more creative". Creativity was mentioned for the first time to be one of the characteristics of expert basketball players. Based on current literature in sport expertise, creativity has not been reported elsewhere as important athletic ability. More research into this aspect of natural abilities will be important for elite sport performance as well as for talent identification and development.

Personal attributes, performance-related attributes and integrated development all fall outside the boundaries of perceptual-motor characteristics, but the coaches reported them as important aspects of expertise. As such, they deserve examination when looking at a complete picture of the top-level basketball player.

Special Comments:

Generally, top-level basketball players were described as "complete players" by their coaches. These observations are important due to the fact that they are able to perform several roles in the game better than their fellow members:

"The biggest thing about top-level players is that they are complete."

"They are those with the most advanced skill, talent and their performance is of the highest level."

There are views that what the eye sees is important and highly appreciated. Top-level basketball players are identified by what they are able to accomplish with the flair of their movements more than what they think. In the do concept, expert coaches described them as:

"Their ability to perform makes them a little more special."

"Usually the best players end around the ball."

'A top-level player's actions speak quite loudly."

However, at such a high level of athletic accomplishment, actions are part of the whole package of expertise. Expert coaches described them as:

"Those who study the game and play the game at a high level."

"Combination of the understanding of how to play the game and their skill and their talent."

In the team performance point of view, they were conceived as:

"Players that make the biggest impact on the team."

"They are key players: A key player has a quality that no body else has in the world."

"One of the best of the best."

Alternative Approaches to Data Analysis

Data collected using the long interview methods can be analysed in other ways. While an alternative approach to data analysis should not lead to conflicting results, the use of inductive analysis to infer themes and categories of meaning from transcripts of the interviews is a "group" method. These methods can obscure the contributions of a single individual to the outcome of the research. Appendix C provides an example of the individual responses of two coaches to the interview questions. These transcripts could serve as the basis for two case studies in which the insights of a single coach could be presented and explored in order to answer the research questions. It may be apparent when reading the individual coaches' responses that the interview takes on the character of a "window" on top-level sport performance that can also be a valuable source of insight in understanding the characteristics of top-level performers. To pursue the case study method formally, a full biographical profile would be needed of each coach interviewed, and his/her comments would have to be interpreted in that context.

Summary

According to the views of expert coaches, basketball is a simple game of skilled reactions and accurate decision-making. Previous research tells us that performance in sports is limited by the skill and knowledge of execution (Thomas & Thomas, 1994). These views have been supported by the findings from the current study. Top-level players can be identified as basketball intelligent. They are good in anticipating, they have quick

minds work within the speed of the game, high levels of memory execution that facilitates adaptation to the game situations. When involved in game situations, top-level players are expert in reacting to the game's unfolding situations with a repertoire of options.

According to the views of expert coaches, top-level basketball players are not only expert in decision-making but also the quality of their decisions is impressive. The process of decision-making can be described as a "dynamic expertise". The flair and precision of the motor skills is influenced by the advanced adaptations of the perceptual skills. Before a decision is executed, other associated parameters must be coordinated and smoothly aligned for correct feedback and deployment of options in case there is a failure of the first one. The basis for expert decision-making is based on the levels of adaptation of the visual perceptual skills in extracting accurate cues from the difficult game environments.

Top-level performers demonstrate conceptual dynamism as they bring in their perceptual and motor skills to the team settings. They are complete players from the point of view that they are able to use their experiences to read the unfolding different game situations much faster than others and decide the most accurate options for motor skill response. Based on the large volume of hours taken for quality practice, their performance is based more on reactions to the game situations (van Rossum, 2000). Less thinking is involved because they are able to keep the game simple by utlising their vast knowledge base.

Conclusions

Theory

In view of the different views on sport expertise drawn from the literature (Abernethy, 1993; Starkes & Allard, 1993; Starkes, 1999; French & McPherson, 1999; Singer & Janelle, 1999; Thomas & Thomas, 1999), the perceptual-motor characteristics of top-level players are linked more to the knowledge structures guiding perception than to the physical aspects of motor performance. Consequently, the qualities of perceptual and motor skills are influenced by the experiential knowledge gained from years of practicing and competing. To the sport science researcher, these observations must be taken cautiously with an eye for further improvement of the existing knowledge of sport expertise. Frequent changes of the rules of basketball have a major influence on the quality and intensity of the game, therefore demanding rational approaches to the performance of the players and the team as a whole.

Expert coaches are a special source of knowledge about the development and performance constraints surrounding expertise of their players. The need for cooperation in sport science research is important. It gives the coaches a sense of responsibility and empowerment to know that their views are highly considered by the researchers. What they see and appreciate is a result of their expertise in putting their plans into action. If these athletes did not attend training sessions given by their expert coaches, there is little possibility that one of them could reach that high level of athletic excellence. This approach will soon create an avenue of having the stakeholders working as partners toward improving the performance of the athlete, therefore narrowing the existing gap.

Application

Identifying the characteristics of top-level performers should be of help to the teachers/coaches in schools and clubs for talent selection and development. If integration of the knowledge with the visual perceptual and motor qualities of skilled performance is important, then specific programs should be designed to develop these underlying characteristics. Based on gradual setting and achieving goals, the youth athletes may ultimately improve beyond the levels of the current top-level players. In light of the limited level of basketball development in most of African countries, the knowledge about the

performance qualities of top-level players should be used as a guide in formulating training programs at different levels of participation in the game of basketball. The aim should be to get at least one or two top-level athletes in every 10 years.

A Final Word

To a top-level athlete, basketball is a simple game but it is difficult for the beginner. It is a game of reactions that depends heavily on the developed level of perceptual and motor skills. The current views of expert coaches on the characteristics of top-level basketball players agree with most of what has been previously reported in the literature. However, the knowledge of expertise in sports is still young. Although visual perceptual skills are important characteristics of top-level players, coaches may not be aware of the need to train visual search skills for their players. While there is emphasis on the importance of visual software skills in the characteristics of top-level players, previous research has not unveiled how these skills can be trained and even improved at the higher level of participation. This is a challenging task in the research for top-level sports expertise. Figure 7 illustrates a possible model to describe the role of vision in decision-making in team sports.

It is important to find out if expert coaches have any specific programs for training perceptual skills. In basketball, vision is a prerequisite for decision-making and performing. Future research should be directed toward establishing specific training and evaluation programs for the players. Where possible, researchers should work together with expert coaches to complete this exercise.

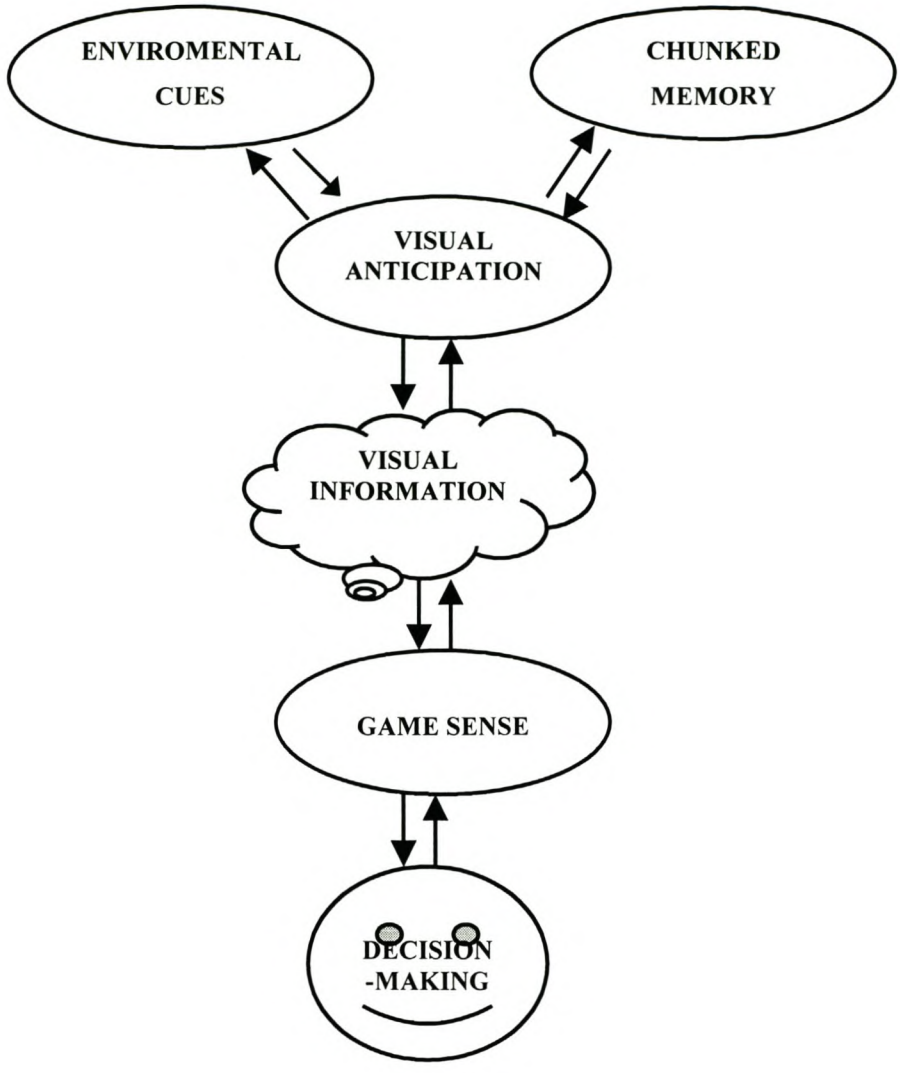

Figure 7

Visual search strategies of Expert Basketball Players

Although the views of expert coaches are important in identifying the characteristics of top-level basketball players, future research initiatives should reconfirm the efficacy of these observations with the elite basketball players. There is need for future researchers in elite sports to place their apparatus to the natural field to observe the players and their coaches in action. What they say is directly related to what they do and experienced. The sport scientist should take the role of facilitating extra information to improve their performance.

Although top-level players are often described by the quality of their motor skill performance, motor skills may not be the distinguishing characteristics that separates the truly "top-level" player from the "very good" players. The underlying components of high level of participation remains a puzzle that needs to be solved. The term "expertise" in sports may need to be redefined to manage the insight generated by research initiatives in sport science. Although not relevant to the scope of the current study, other characteristics such as psychological attributes, love of the game, work ethics, physical attributes, talent, creativity, team culture and diet were mentioned by expert coaches to be potential characeristics that identifying top-level players. Further investigations should be focused to each of these factors in relation to the different sports. As long as the study of expertise has a multiple perspective, research should be broad at this early stage of the notion of expertise.

APPENDIX A

Questionnaire for the Long Interview

PHASE ONE: Starting the interview;

1. Could you tell me about the background of your involvement in the sport of basketball?

2. Why did you decide to become a coach?

3. What is your coaching philosophy and how important is it to the elite basketball performance?

PHASE TWO: (Aimed at present coaching activities and experiences gained)

4. What do you like most in coaching elite basketball players?

5. If you were asked to select an Olympic basketball team for your country, what specific performance characteristics possessed by elite basketball players would be significantly considered in relation to your philosophy of the game at this high level.

6. What are the current performance problems in relation to what you said?

7. How would you adjust the team performance to compensate the missing link i.e. to maintain your winning formula as may be replicated by your coaching philosophy.

8. The current level of elite basketball performance is higher than that experienced in the 70s and 80s. Could you tell me generally about the critical performance factors determining these performance differences?

9. It is generally said that it takes ten years for one to become a basketball expert, but we have not heard how long it takes to become an elite basketball player. Could you comment on this?

10. Expertise in basketball can be demonstrated in different age groups of playing, e.g. 12-13, 14-16, 17-19 and so on. Each age group has a specific expertise that is different from the other. Based on your experience, what are the main components of expertise at top-level basketball performance?

11. How do these components of expertise developed?

12. What else has been forgotten that you think important to be mentioned?

VIEW BASKETBALL GAME IN THE VIDEO TAPE FOR 10 MINUTES AND HAVE DRINKS.

PHASE THREE: (questions aimed at probing the meaning of their experiences)

13. In relation to what you have said about your involvement in the game of basketball and how you became a successful coach to date. What is it that makes elite basketball players more successful than others?

14. Why is knowledge about the game of basketball important at the elite performance level? Please give examples as you explain.

15. In which aspect is knowledge about the game at top-level performance different from the general knowledge of expertise in basketball performance? Can you give me specific examples?

16. Looking at the elite performance level, how and what environments and situations can best explain the link between the game skills and the knowledge of the player. Please give examples to support your ideas?

VIBE; VIEW A BASKETBALL GAME IN THE TAPE FOR 5 MINUTES

17. Specifically, what performance qualities explain the superiority of the elite basketball performer?

18. How do these qualities manifest during different game situations and how do other players cope with them?

19. What do you think about game intelligence at elite level of basketball performance?

20. What criteria do you use to evaluate the performance of elite players and the team in general?

21. How is anticipation important in top-level basketball performance?

22. In which way is recall of memory about the special game situations important in elite basketball performance?

23. What performance factors are important in perfecting and strengthening teamwork at the elite basketball performances level?

24. What else would you like to add that you think it is important as far as elite basketball performance is concerned?

25. During game situations, elite basketball players are quick and accurate in their movements. How do they facilitate information processing so as to accurately make accurate decisions and perform correct movements?

26. Learning does not stop in human life. How far is this statement true at the elite level of basketball performance? Please use examples to help others understand well.

THANK YOU VERY MUCH FOR YOUR COOPERATION

APPENDIX B

Units of Meaning

Fundamental Skills

- Basics of the game
- Solid foundation
- More than developing fundamental skills
- Rebounding - all the time
- Defence
- Offence
- Shooting
- Introduction to basketball
- Eye-hand coordination
- Footwork
- Ball handling
- Catching
- Small moves from catching the ball to bringing the ball up
- Improving his shooting technique
- Improve bodily positions to little things details
- Do all the time
- Basic skills
- Chest pass
- Fundamentals do not change
- Fundamentals of basketball
- Great fundamentals
- Spend most of their life on the fundamentals of basketball
- Many fundamentals in defence
- Their fundamentals become better

Motor Skills

- The slum dunk
- Wear everybody
- Fancy dunkers and ball handlers
- Degree of more skills
- Develop all those skills
- Good balance
- Important to shoot the ball
- Shoots the ball
- Like Coby or Jordan that dribble and pass
- Their skill level
- Work out fundamentals and skills
- Has excellent fundamentals
- Have developed skills
- Guys who can shoot the ball
- Shoot three points
- Skilled
- Quick shots
- Ball is played in the air
- How coordinated are they
- How graceful are they
- Different types of moves
- Shoot the ball on the same technique
- Advance level of playing
- Master the skills
- Refinement of the skills
- Very skilled
- Have a lot of skills
- Certain skills that you can see they are different
- Very refined almost like a Ferrari
- React a little bit faster
- Able to adapt
- How well do they shoot
- Things happen in seconds
- Great skills
- Quick movements
- Fast break
- Their skills are much better
- Extra skills
- Their skills are brought to perfection
- Reaction
- Players that have to execute
- How fast is the release of the jump shooter
- It is all about reaction
- Have better skills than the rest
- Their skills are better
- Knows how to make a pass
- They have skill advantage
- A lot of what they do is reactive
- He passes better
- Happen very rapidly
- Become automatic to see the options
- React to it quickly

Tactical Skills-General

- The last seconds shots
- More options coming everyday
- Different options
- Certain conditions
- Basketball has improved tactically
- They practice longer
- Read the situation before others and make the right move
- Tactical game
- Use their weaknesses
- They see what is happening
- Depending on our own personnel
- Like chess –tactically
- Team tactic
- Tactical decision during the game
- Have the advantage

Tactical Offense

- Set motions that allow to be free
- Tactical preparation
- Trusting to pass the ball in the last minute
- Come from to get open
- Know where is the next screen from teammate
- More trusting to pass the ball
- Certain situations
- Isolate one player
- A loose ball situation
- Put in a position
- How we attacked
- The defense influence the decisions of the attack
- Consistency of the offensive play
- Offense
- Able to take advantage of the switch
- Knock down 20-25 points per game
- Potential to score every game
- Really want to attack in
- Offenders read the defense
- What our opponents do on the offense
- They counter everything
- More about how many offense we got
- The way we run our offenses
- Reading the defense
- Offense is important
- Take away what the defense is giving
- Tactical aspect of the game
- Not predictable stuff
- A lot of the tactical motion stuff
- Able to change and adapt
- Players seldom make turn-over
- Many situations reoccur on a regular basis
- How to use those skills in play effectively
- How to apply your skill level
- Ability to score
- Situations reoccur more than well
- Adjustments in the game make a difference
- Situations
- Finding that extra solution
- Individual tactic

Tactical Defense

- Great defensive players
- Man to man
- Extend that man to man
- Defensive player will always stay with
- Consistence of defensive play
- Need to stop somebody defensively
- Disturb team plan of the opposition
- Delivering the defense
- Defense is important
- Opportunities to trap the ball
- Force them to make a pull-up jump shot
- How we play the defense
- Defense is important

Learning

- As soon as you sit back and relax, another player takes over the position
- You can always improve
- Willingness to learn
- Listening with eyes open
- Being coachable
- His ability to understand the game
- Learning does not stop
- Learning takes care itself
- They learn from their coaches

General goals

- Achieve success
- Goals to achieve

Specific Goals

- Specific goals
- They set themselves their objectives
- Hold the goal
- The same objective
- Professional basketball
- Playing in the national team
- Follow through to score those numbers

Evaluation

- Testing to see kind of improvement
- The reason for winning or loosing can be different
- Criteria
- Making progress
- Overall evaluation
- Assessment
- How often do we get the ball
- Decide who they are by themselves
- Tale charges throughout the game
- Evaluate our play
- Can read about them
- Written reports
- Evaluate our team
- Take in consideration what we were up against
- Statistics of the game
- Measure up self
- Understand what their game needs to improve
- What performance did you have offensively
- Have those improvements

Anticipation

- You visualize situations
- It is all anticipation
- A good defender is good at anticipating
- Anticipation in offense
- It is a key to a game of reaction
- Knowledge where the next is going to go
- To know that he is going to screen
- Knowing where next pass is going to be
- Knowing how the player is going to move
- Being a step ahead
- Players see the opposition in three ways
- Know what is the next step
- React properly against the opposition
- They think upfront
- React on signs that they know

Memory- How/volume

- Decisions based on something that has been successful in the past
- It is just a bunch of replays
- Seeing the different scenarios over and over
- In a game, you remember the games you have played
- In a game, your mind immediately goes back
- The more you play the more memory you have
- Elements that guide your decision
- Same situation happens all the time
- Memory improves through number of repetitions
- Practice through repetitions
- Raise above what you have done in the past years
- Complex way of utilizing the memory
- They come every day
- Comes through every practice
- Involves less thinking because the situations occur all the time
- At such high level he does not have to think
- The more you know the less thinking takes place

- The more times you are in the situations, the less easier it will be
- Have the ability to forget what has happened before and focus on the task at hand
- They are at their highest performance when they are not thinking
- There is not a knew situation that needs to think about
- The more you know the easier it is going to be to react
- Knowledge of what has happened before is important
- How much they understand the game
- Hopefully your memory will train your instincts
- Recalling our game
- Recall
- The game is too fast to be recalling every time
- Things you remember become your instincts
- Memory is important
- How you play
- Things coming back from preparation before the game
- Thinking that develops into reaction through years of experience

Applied Knowledge

- Important to have knowledge of the game
- Smart players
- Learn to read the game
- Today's players know much more
- They go into so much little detail
- They are much more educated than those 20 years ago
- Player's knowledge
- Selection
- Difficult to say who knows more about the game
- They know the game very well
- Change the concept
- Learning never stops
- It is application of the knowledge that makes the difference
- Understanding of the game
- From a team perspective
- More about understanding at that level
- Skill has to be developed alongside understanding
- Experience of playing at top-level
- Knowing that he has been scouted
- Knowing that he it is the final
- Every defender is a different defender
- Understand their roles in the game
- Every game is different
- Know what to do
- Have to improve their knowledge
- The more you know-information is power
- Sharing knowledge improves playing
- Understanding of the game
- They want to know
- Able to describe basketball to people
- Basketball in the internet

Knowledge -Rules of the game

- Rules of the game
- Rules stimulate the game
- Rules motivate the game
- Rules changes
- Influence huge changes in the game
- The three point line
- NBA teams be allowed to play zone defense
- Basketball is game
- Never allowed to do that
- 8 seconds to get the ball over the other half instead of 10seconds
- Force them to play faster
- Utilizing the rules
- Time outs
- Shot clock
- You have to understand the rules

Decision-Making

- Some decisions
- Players have to think
- While they react they all this time think
- What of quality decision-making
- Basketball intelligence
- Personal decision-making
- Players who are going to use their brain
- Decision-making while playing
- Use good judgment
- They do think
- Make a decision
- Quick ability to make decisions
- Knows when to take a shot
- When to make the right decision
- Ability to make decisions
- Top thinking
- Decision-making is trained
- They think all the time
- Options help them make decisions
- Their decisions can not be controlled
- They make choices
- Good decision-makers
- Goes back to the whole game concept
- Decision-making is huge
- Everybody thinks differently
- Everything is about choices and decisions
- They have to think very fast
- It takes time to think while playing
- Able to make better decisions

- It is more than decisions
- Better decisions
- Decisions they make for better

Speed of processing Information

- Find solutions in the split of a second
- Many things happening very quickly
- Processing whatever is happening on the court
- Good player acts mechanically
- They have the ability to think quicker than others
- The quicker you can make decisions, respond or react the better
- They are able to process information in their brain faster
- They react more than they think
- They think within the speed of the game
- They learn how to think rapidly
- Most of them do not think

Ability of the Mind

- Can learn things quickly
- Their abilities
- The ability to be a little quicker than the mind

Quality of Practice

- Tactical part of the game
- Pushing another level
- Something you are going to show on the court
- Continuity of practice
- Complicated movements
- Players can improve every time
- Mechanical movements
- Preparation before the game
- Different ways of practicing
- At top-level, the approach to training is much different
- We have to change
- Simple movements to become automatic movements
- Get developed
- Just doing little things
- Keep it simple but people make it too complicated
- Develop all the skills
- It all depends on the player
- Work with other players to raise their level
- Very deliberately
- Makes them more successful
- Technical part of the game
- The strength lies with good training
- Every aspect of the game needs to be covered
- Become more advanced

Quantity of Practice

- USA-NCAA train four per day
- To get with time
- The amount of time spent on the court is much higher
- Training quantity
- European teams train 4-5 hours per day
- SA-teams, train x20 hours less in a week
- European players-train 20-25 hrs per week
- In Europe, the basketball season is eleven months
- Average player plays between 60-80 games per season
- Participate
- Need 6000-7000 repetitions to learn a complicated move
- Doing it on a day to day basis
- Make a lot of repetitions
- NCAA train 20 hours a week
- Learn a little bit more
- Most of the meetings
- Time to really work on our team
- It does not take that long
- Strategy does not make them more successful
- Practice them time after time
- Spend a lot of time practicing
- Years of high training programs and competitions

- They practice a lot
- Rebounding the ball, they learn over and over
- A professional plays 3000 games in his career
- Play most frequently
- They practice longer
- Hours and hours of playing basketball
- They play all day

Training Program

- Need space
- The French team had twenty preparation games before the Olympics
- Preparation games
- Preparation and approach to preparation
- Transition period
- Different stages in the program
- Things that you do prior to the game
- Have a program
- Proper preparation
- Playing conditionally
- They set themselves during the season
- You have to develop all the time
- Off-season program
- Need to go through periods
- Planning
- Training level changes
- They train really hard off-season

Competitions

- During competitions
- Competitions away from home
- Play at high level
- Connecting to competitions
- Official games
- Friendly games
- Makes them better and better
- Continuity of games
- Competition season
- Play six months
- Competitions

Facilities

- The equipment and money that Jordan has

Culture

- They change as society changes
- May be that makes up their culture
- Create the culture that top-level players have
- If top-level players have the culture, it is their attitude
- Culture has to do with people
- Have their own culture
- Establish the same kind of culture
- Society changes

Teamwork

- Teammates think that he is ok
- How to play with other players
- Help one another quite nicely
- Rest of the teammates do the same
- You are just part of the team
- Work with teammates
- Teammates
- Our team correctly does this
- Team success
- Affect the rest of the team
- Enable you to trust your teammates
- They need to get along
- Teammates don't have to be friends
- Team working together
- Make a team
- Between them
- Stay on the ball for the team
- Who is going to work together the best
- How they interact with their coaches
- Being able to relate to the star of the team
- Making them feel important
- Unselfishness team work
- Being able to realize that they have teammates
- A top-level player supported by another four
- It depends on the game and the teams that are involved
- Teams are different
- Telegraphic ways of communicating
- How players communicate each other
- To communicate
- All together is what NBA is
- These players also part of the team
- They work as a team to refine the team
- Proper use of the teammates
- The team concept
- It is all Team performance
- It is about Team effort
- Individualism-team concept
- Approach to the team work
- Amount of communication

-
- Other players with their team mates
- Doing through practice
- Chemistry between the team members
- Players like each other
- Feel what is going on
- Good chemistry
- Feel about his players around
- Every team is going to practice and practice
- Stability of certain players
- Players have been playing together for 12-14 years
- You practice together
- Know each other well
- How players are matching
- Form the team
- Rely on your teammates
- How they do the little things that make the difference on the team
- Relating to the guys on the bench
- How they interact with their teammates
- How to play as team
- Develop team-work through strategy
- When you rehearse and practice those situations sum-up
- Successful players work together
- Role players
- Comfortable play
- Type of character the person has
- How well they fit into the team
- Relations with players is important
- Being a team player with them
- Individual skills they bring to the team
- Team structure
- Team gets better

Leadership/Roles

- Delivering the brain of the team
- He is a born leader
- Have one player as the top player
- Brain of the team
- A leader
- Able to put the guys around him to another level
- They push their team-mates
- Certain leadership in some way
- What kind of leaders are they
- Always watched by their teammates
- A lot of it happens off the court
- Understanding the roles
- Certain leadership skills
- Leading by example
- Know your role
- Motivate their teammates
- Gets all players together all the time
- One that earned that leadership
- To be the leader
- Earned leadership with his approach to the game
- Earned leadership with his behavior
- One that sends out message to rest in the team

Commitment

- When there is no fan
- Everybody in the team has to be committed
- Where there is no money
- Dedication to themselves
- Having committed to each other
- Committed to the team
- Committed to winning
- Their overall dedication to their team
- Commitment and attachment
- The determination
- Players agreement

Discipline

- How they manage their program
- Able to push themselves to their limits more than average player
- Respect agreement
- They have discipline

Desire

- To make some of a difference
- Their desire
- What enables them to do
- Your desire
- How bad they want it
- It comes down to desire
- Their individual desire to score
- It is about desire and working
- Want to achieve that
- Willing to play ball

Persistence

- Going to every game
- Every practice
- Can be successful
- The consistence of performance
- Difficult times to achieve their goals

Respect

- Honor for the player
- Players as human beings
- Amount of respect

Confidence

- I think we are able
- Confident players
- I believe in some structure
- How much confidence they have
- Self-belief

- Feel mentally you have the ability
- Believe that things will work
- Become confident
- Expect things will work out

Courage

- I believe
- That is their commitment
- They have courage

Serious

- Make sure it is done
- Treat it with amount of importance
- Our sport is very serious

Competitive

- Through their competitive nature
- Competitive nature
- When a basketball team wins
- Players decide who wins and who looses
- Winning is what matters
- Winning at all cost
- Players played the hardest
- We did our best
- Competent at the highest level
- Know when to raise their level
- Aggressive
- Their ability to raise above all the difficulties
- Being competitive
- They succeed, they do it well
- Competitive persons
- They are the winners
- Establish himself a s a winner in the match
- Able to explore opponent's weakness
- Analyze the opposition before the game
- Players who try to be better and better every day
- Makes a difference between those extra good players and the rest
- Those extreme movements

Mental-Strength

- Part of the mental aspect
- In terms of mental toughness
- They are also a step ahead mentally
- How tough are they mentally
- The mental aspect of the game
- Basketball is a mental game
- Psychological approach of the game
- Able to bounce back after big failure
- Prepared mentally
- Psychologically, how they perform under pressure
- It is psychological
- Psychological toughness
- Train psychologically
- Very psychological game
- Those that are mentally stronger will be top guys
- Guys who mentally are the strongest
- Psychological part of the game

Nature

- Most talented players
- Has to do with athleticism
- It is not that they are tall
- He is absolute freak of nature
- Players that are a step faster physically
- They are already a step quicker athletically
- A player that is naturally athletic
- Things they can do physically, normal people cannot do
- Have to be physically gifted
- End up to be tow steps quicker than everybody
- Have the gifts from God
- Talent overweighs the fundamentals
- The most talented point guard
- The most talented scorer
- Extra talent
- Basketball talent
- That is pure nature
- Talented players are half a job done
- I think the talent is there
- Key qualities are the qualities that will stand out that cannot be coached
- They are just more gifted
- I think the natural athletic sills are there
- I think it is natural
- Some God given ability

Focused energy

- Walk it through
- Totally focused
- Close off certain aspects
- Being in the zone
- Bring energy in the game
- The energy level of your team
- Transform energy
- The energy you have to use to perform at a very high level

- The focus at driving your energy toward being the best
- It makes my energy very focused
- It makes my concentration very focused

Up bringing Parents

- Their parents care

Upbringing-Opportunities

- As you grow up to different levels you play more games
- Better opportunity to be successful
- Went for trials and was chosen
- New players come into the game
- Opportunity
- Put and grow all those qualities together
- Provide a lot of opportunities for kids
- It takes ten years of focus and dedication
- An athlete is at peak between 26-30 years
- As you grow older it becomes harder
- From a very young age
- In the end two or three will stand out
- Background in basketball
- College age kids
- Complete my basketball education
- Juniors
- High school basketball
- To be all rounders so that they can develop
- Able to play all the positions
- Playing on video
- High school program
- It may be his upbringing
- How his parent treated him as a child

Up bringing Facilities

- Requirement facilities
- Modern Infrastructure

Up-bringing-Early start

- It is important to start early
- First time in the gym. a kid wants to shoot
- Produce talents
- Young age
- A lot of basketball players do things instinctively
- You need to have those instincts
- It becomes instinctive for the player
- They train so as to have their instincts take over
- Their instincts are so incredible
- Unbelievable instincts take over
- It is like the "do" factor
- Some play all out of instincts
- Being identified
- It takes a lot of hard work
- It takes about five years to understand the game
- With a different style
- They start at small age
- It takes a bit of time
- It is a process
- New generation coming in
- Only play basketball
- When kids are growing up
- Basketball at young age
- A ten year old and Michael Jordan dribble the same
- Common for athletes to play multiple sports
- The only sport they play

Body/Mind

- The more you play, the quicker are the reactions between the your brain and the body
- There is a dual training effect
- Train their body and mind

Individual

- Just the player, the ball, the gym. And the basket
- Performing individually
- A good team has good individuals
- Raise above that level
- Every body is different
- It depends on the development of the person
- To improve your personal abilities
- Program should fit the individual abilities
- They train as individuals to refine their game

Personal Development

- They become more entertainment
- Pro-basketball has changed in the last 20 years
- Pro-athletes make more money now than 20 years ago
- The skill level of NBA players continue to drop gradually
- Pro-players are now movie stars
- The NBA is much more athletic now than it was 20 years ago
- The NBA is less skilled than it was 20 years ago

- Taught going to the NBA and now they do
- Professionals are most talented players

God given abilities- Instincts

- React naturally
- It just happens
- Do things instinctively

Creativity

- A number of options for one situation
- Each has to know those options
- They are creative
- Able to create opportunity for you and the team
- Become more creative
- They become more creative as the game gets more complex
- Creative individualism

Diet

- "I eat a healthy meal before a big game"
- Guys who have the most discipline on what they eat

Physical Attributes

- Size and skill level
- Bigger and Quicker than
- Players that size, create disadvantage to the opposition
- I would get all vertical players
- Bigger more athletic players
- Their physical attributes
- It is about how you are built
- How long their arms are
- How big their hands are
- Height
- Quickness
- Weight
- Short players are fast and smart
- Size of players
- Much more physical game
- Who is dominating
- Versatile players
- Profile of players
- Their physical abilities
- Tall and quick players
- Strong players
- Brought their excellent physical abilities
- It is just physical game
- Their physical abilities are just much better than tactics/strategies
- Physically they are head and shoulder above the rest
- Players are much bigger today than 20 years ago
- It comes down to how big they are
- Physically able
- Their strength

Jumping Ability

- Can run and jump
- Have natural athletic jumps

Fitness

- They are athletic
- Tall and graceful
- Physically bale to carry out the actions
- Helps them sustain their physical conditioning
- Great conditioning
- Great off-season training programs
- Able to sustain their physical conditioning
- Strength programs
- Dedication to their health
- Good in shape
- Some body who is stronger
- Have optimum conditions
- Physically-how strong and quick they are
- Stronger and faster
- Acceleration of the athlete
- There is no extra fat, it is lean, it is fast
- Have a very lean body

Love of the Game

- Love of the game
- Demonstrate enthusiasm
- Attitude with gratitude
- Just being happy
- They love basketball

Work Ethic

- Find time for each of those things
- How hard they work
- Work harder when there is no coach
- A top-level player gets to practice a half hour earlier
- Work by themselves
- Able to put all that to work in
- Personal motivation is important
- To play hard
- Desire to work hard
- How hard they work
- Team work building attitude

- Their attitudes to the game
- Acquired working habits
- Form habits
- Have certain rules
- They are willing to work
- Guys who work the hardest way
- They play harder
- They spend most of their time conditioning their bodies to stay at top-level
- It is that 10% or 20% extra hard work to be better

APPENDIX C

An Alternative Approach to Data Analysis

There are other methods of analyzing data generated in interviews, including the case study. From a case study point of view, the following views of expert coaches are important in explaining the performance qualities that identify top-level basketball performers:

Question 1.

If you go to see two unknown basketball teams competing, how would you identify the top-level players in those teams?

Coach Y:

In scouting for players like that, you basically look at all the basic fundamentals – offence and defense, are these players performing individually and within the team frame concept. So from there you can make a judgment.

Coach X:

To me it would all be attitude. I would look for guys who can shoot the ball, great defensive players. That would probably be the two things that I would look at. The biggest thing for me would still be their attitude. Ok, I would describe them as the players that made the biggest impact one the game. They are the ones always around the ball – offensively, defensively. You watch the game but in the end, two or three will stand out. I would say unless somebody has unbelievable, one particular quality, then I would say that the biggest thing about at top-level player is that they are complete, they can do everything.

Question 2

How long does it take for a basketball player to become a top-level player?

Coach Y:

It takes a lot of hard work. It takes a bit of time. I really cannot think that in numbers. I believe you need to go through periods. Those go from your introduction into basketball to the refinement of your skills and the mastering of your skills. It is much easier for a kid who starts at a small age. It is a combination of leadership. One is to motivate their teammates enough to play hard the game. The second one is leading an example – scoring more than anyone and so on. It is more about motivating the rest of the team.

Coach X:

I think it would completely depend on the player. If a player is naturally athletic, they can learn things quickly and so on, it doesn't take that long. But to develop all of the skills, I don't know the number of years, but it takes time.

Question 3:

These top-level basketball players, they can play over many seasons, but their performance does not drop. What performance qualities or what kind of training do they do to maintain their top-level performance.

Coach X:

Great conditioning, great off-season training programs, strength programs. Those things help them sustain their physical conditioning. What enables them to do that is their commitment and their desire to put all that work in.

Coach Y:

Very seldom their training levels change. You find that in off seasons they train really hard. It is the objective that they set themselves during the seasons. They set themselves their objectives and they know when to raise their level. If you do that and you have good coaches, but the personal motivation is also important.

Question 4:

If I say top-level basketball players have their own culture, how do you understand that?

Coach X:

They might have their own culture. Like if you took the other players that weren't as good and you establish that same kind of culture within that players who weren't as good, they are still going to loose to the better players, so I don't think you can do anything to create the culture that top level players have between them for other players to raise their level. If top level players have a culture, maybe more than anything it is their attitude – how hard they work, how much confidence they have in their abilities and their overall dedication to their team, themselves and their health. Maybe that makes up the culture.

Coach Y:

Being a player myself, I know that it is also called being in the zone. It is a high level of concentration. You have to be able to close of certain aspects of the game which is the noise, the coach, and that is why they succeed, they do it well.

Question 5:

Do top-level players really think when they play?

Coach X:

Some do and some don't. Some play all out of instincts. I would say most of them don't think but their instincts are so incredible that they do things that others think they did think. I think the speed of the game is so fast that I don't think that there is time to think but I am sure they think during time outs. They think on the bench. But when they are actually playing, I think you train your instincts to take over.

Probably that is where the coach has a big impact. Showing players certain strategies and certain situations. And saying that when A happens, you must do B to be successful. Until it becomes instinctive for the player. And then there is no thinking

Coach Y:

Well, it takes about 5 years to understand the game. From there basketball being a game of reaction – from there you adapt to react quickly within the speed of the game. They do think and they do think a lot. They know what to do – they learn how to think rapidly.

With the rules of the game, things happen in seconds, so things happen very rapidly – they are not predicted stuff. A lot of the tactical motioning stuff, you need to be able to adapt and react to it quickly.

When we say thinking, after experience of playing at top level, your quick ability to make decisions become more advance. You practice them time after time, so it is more of an aspect of good decision-making that they learn from their coaches than just thinking.

Question 6:

In what ways do you think is knowledge of the game important for top-level basketball players to be successful?

Coach X:

I mean you have to understand the rules, how to play with other players. You can be a good athlete who has excellent fundamentals when you work by yourself, but then when you work with team mates, when you don't understand that you are just a part of that, then I think you can have the talent but you can be unsuccessful.

Coach Y:

This is decision-making again. You visualize situations. The same situations happen all the time and you practice that. It has become less thinking because the situations occur all the time.

Question 7:

Looking at the athleticism of a top-level basketball player. Is there a balance between their physical abilities and their knowledge of the game?

Coach X:

You watch them play. You can read about them, you know. Let me put it this way; the best players in the world usually have three characteristics. They have the best physical abilities, the best skills and the have the best understanding of the game.

I would say that the top-level players have both. Michael Jordan has both.

You watch them play. You can read about them, you know. Let me put it this way; the best players in the world usually have three characteristics. They have the best physical abilities, the best skills and the have the best understanding of the game.

Coach Y:

They balance and they go together. If you are not in good physical shape, you are not going to play at high level. Again the tactical aspect comes in, so it is a combination of both.

Question 8:

Do you believe that decision-making in basketball can be trained?

Coach X:

I think you can but certain players are going to be more receptive to that training and they would be able to make better decisions and others won't. So I think you can make an impact on some players. The other thing is that teaching players from a very young age, allows them to understand things better. As you grow older, I think it becomes harder.

Coach Y:

Oh yes, decision making are trained and a lot of repetitions will help the players to adapt to certain situations during the course of the game. You as a coach, you explain situations, but you still don't control their decisions.

You do give a number of options for one situation. Each individual have to know these options. But you create individualism as well. They make the choice. But there are always options. So the options are what help them make decisions.

Question 9

What performance components do top-level players use to coordinate the performance of their fellow players in the team?

Coach X:

Certainly leadership in some way, whether it is by example or verbally. I would say that is the biggest thing. Through their competitive nature, they push their teammates to raise their level of play. When it comes to a very difficult game, then it has become more to put in your creativity as a player to rise above that situation. Because you are a top-level player, you have to create opportunity for you and your team. So you have to be more creative.

I think top-level players; they have to understand they are always being watched by their teammates. Often just by their actions and if they go out and party the night before the game, the team mates are going to think that is ok. In the end, the team is going to suffer. When the top-level players say: "I eat a healthy meal before a big game", then the rest of the rest of the teammates are going to do that. I think the same thing is true if a top-level player gets to practice a half hour early to work out his skills and fundamentals. Then that is what the rest of the players are going to do. If a top-level player arrives a second before practice, the rest of the team will say it is ok to do that. I think a top-level player's action speak quite loudly.

Coach Y:

Leadership. A leader gets all the players together all the time to hold the same goal, the same objective. During a competition being away from home or just being in a competition in itself have the potential to devalue the team because of the spectators or so on. That is where the leadership comes in. I don't think any tactical things really come into that.

Their ability to raise above all the difficulties. To be able to change and adapt. When it comes to a very difficult game, then it has become more to put in your creativity as a player to rise above that situation. Because you are a top-level player, you have to create opportunity for you and your team. So you have to be more creative.

When it comes to a very difficult game, then it has become more to put in your creativity as a player to rise above that situation. Because you are a top-level player, you have to create opportunity for you and your team. So you have to be more creative.

Question 10:

What do you know about the tactical and strategic advantages of top-level basketball players?

Coach X:

Strategically, top-level players since they are already a step quicker athletically, they end up to be quicker than everybody because they are also a step ahead mentally. They know where the pass is going to go. The know where the next screen from the next teammate are going to come from to get the open. Maybe before the person over there is going to know that is going to screen! They are always a step ahead mentally. They are already a step faster physically and in the end they help one another quite nicely. I would say in terms of mental toughness, a top-level player will be able to work harder when there is no coach, when there is no fan, where there is no money. It is just the player, the ball, the gym and the basket. The top-level players will be able to push themselves to their limits more than the average players. That is what separates them.

Tactically, it is more than decision-making. It is reading what the defense is going to do. I think most offender players they read the defense. They see what is there and the top-level players and they counter everything. The most of basketball is reading and reacting to your opposition and then physically be able to carry out that next action that has to take place.

Coach Y:

That is very important. Very important at top level. You cannot play without any tactical preparation. I don't think there is much you can do except to try to understand the game. Again, in having a game plan, you require good scouting. If the game becomes more complex, you as a player become more creative. Again a top-level player should be able to know that.

The implementation of proper use of the teammates. For example. A defense player will always be able to stay with you. So you would have to be able to take advantage of the switch. So decision-making is the implementation through the team concept.

The opposition can influence the tactical and strategy of the game. But again, we say to our players, try to take away from what the defense is giving you. Use their weakness. So yes, the defense influence that.

Question 11:

Do you think that anticipation is important in top-level basketball?

Coach X:

Absolutely. I think that is part of the mental aspect. Being a step ahead. Knowing where the next pass is going to go. Knowing how all the players are going to move.

Coach Y:

That is the key to the game of reaction. It is all in anticipation. A good defender is always a good anticipator. Offence the same. Your reaction what follows is what the defense has given you. So yea.

Question 12:

How much important is the memory of top-level players in the game of basketball?

Coach X:

Memory is important. Hopefully the things you remember become your instincts. Because the game goes too fast to be always recalling your memory. Eventually you need to have those instincts. Hopefully your memory will train your instincts.

Coach Y:

It is a very complex way of utilizing the memory. What we prefer as coaches is to have enough practice through repetition, so that players will become automatic to see the different options coming. Your memory really improves through the number of repetition. Certain moves then become automatic.

Question 13:

How do the top-level players use their position to the advantage of their team?

Coach X:

Every decision they make for better or for worst is going to affect the team so the top level player makes a bad decision – goes out the night before the game or comes to the practice late – then those bad decisions are going to affect the team. Everybody thinks that is ok. That is what the best player does. If the best player does the right thing all the time, all of those decisions, they affect the rest of the team because the rest of the team is constantly observing.

Coach Y:

In order to have a good team, you have to have good individuals. Every pair need to understand their roles in the game. Those two components together help to introduce the team concept. You cannot have a good defense if one player doesn't play good defense. So it starts with individualism.

Question 14:

Learning does not stop. How far is this true to top-level basketball players?

Coach X:

O yea, I would say so. It is a simple game – people make it too complicated but at the same time there is just little things that you never thought of and somebody says it differently and then you learn a little bit more. If somebody thinks they have all the answers, they are usually kidding themselves I would think.

Coach Y:

That is true. Every game is a different game. Every defender is a different defender. Every coach has a different philosophy, so you need to adapt to that. You have to develop all the time. It is very important. When you stop learning, which is when you should actually stop playing the game.

It is the competitions. In order to compete, you have to keep on performing and players, coaches etc. see you all the time playing on video and if you don't raise above what you have done in the past couple of years, there is always new generation coming in – with a different style and you need to be able to defend that. So there is a lot of factors that keep people motivated to keep on learning. One can be money, the love of the game, and the love of winning.

Question 15:

Is there anything else that was not mentioned in our conversation that in your opinion it is important in characterizing top-level basketball players?

Coach X:

I would say it is just always important to keep the game very simple and the best players more often than that will decide who they are by themselves. Sometimes the criteria of the best players, the top level players might change as society changes or as players changes but I think the things that you were asking, you know, you have to be physically gifted, you have to have developed skills and then you have to have that mental component. That is what makes it a complete component.

Coach Y:

As far as top-level basketball is concerned, players don't necessarily become top level players in one season. Only through years of high training programs and high competitions in order to get to that level. It is very important for coaches to understand that practicing doesn't necessarily make players become top- level or perfect. Every aspect of the game needs to be covered. As coaches you have to train young people to be able to play all the positions – to be all rounders so that they can develop. One of the biggest, 90% of the game is mental, the other is physically and tactical.

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