FACTORS ASSOCIATED WITH SUCCESS IN SOUTH AFRICAN RUGBY UNION

A DISSERTATION PREPARED BY ZIYAAD-AHMAD PARKER (PRKZIY002) IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF PHILOSOPHY DEGREE IN BIOKINETICS (MPHIL BIOKINETICS) FROM THE UNIVERSITY OF CAPE TOWN

8 FEBRUARY 2013

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Factors Associated with Success in South African Rugby Union

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DECLARATION

I, Ziyaad-Ahmad Parker, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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(Date)

ACKNOWLEDGEMENTS

I would like to thank the following people for their support and assistance in completing this thesis as part of my requirements for the Master of Philosophy in Biokinetics postgraduate degree.

- My parents, Sedick and Hajirah Parker
- My friends and family
- My supervisor, Professor Mike Lambert, PhD
- Justin Durandt, Manager, High Performance Centre, Sports Science Institute of South Africa
- My course coordinator, Tracy Kolbe-Alexander
- Dr Sharief Hendricks, PhD
- National Research Fund (NRF)

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LIST OF ABBREVIATIONS

CI – Confidence Intervals

DMGT – the Differentiated Model of Giftedness

DMSP – the Developmental Model of Sport Participation

LTAD – Long Term Athlete Development

MTTS – Mobile Team Training System

SA – South Africa

SARU – South African Rugby Union

SD – Standard Deviation

SEE – Standard Error of Estimate

U13 – Under 13 years of age

U16 – Under 16 years of age

U18 – Under 18 years of age

ABSTRACT

Background

Rugby Union is a popular sporting code in South Africa and the national team (Springboks) has won two World Cups (1995 and 2007). As the pool of players to select the Springboks from has diminished in recent times, it is important for the South African Rugby Union (SARU) to identify and develop young, talented individuals to strengthen the pool of available players. Several talent identification and development programmes have been implemented by SARU with limited success and many of them are not offered anymore. Apart from the national age group tournaments (U13, U16, and U18 Craven Week), it is evident that there is no clear talent identification and development model being implemented by SARU.

Objective

To identify factors associated with success in South African rugby union players who have already achieved success at the highest level.

Methods

Data for all the rugby players (n = 147) who made their debut for the Springboks between 1 January 2000 and 31 December 2010 were collected from their individual player profiles (www.sarugby.co.za). The analysis included the following components: self-reported mass, self-reported stature, school attended, self-reported birthplace, and previous playing history. Furthermore, data were obtained from the official match programmes of each U18 Craven Week from 1987 to 2008. These programmes included self-reported mass and stature of each player that participated in the U18 Craven Week. Population statistics were obtained from the South African Government's Census (www.statssa.co.za) for all the cities and provinces in South Africa.

A t-test was used to determine the significance of the differences between the Springbok forwards and backs and between Non-Springboks and Springboks at Craven Week ($p<0.05$). The effect size was

calculated in order to determine the magnitude of these differences. An effect size of <0.2 was regarded as "trivial" while an effect size of >0.8 was regarded as "large". Quintiles were calculated for the population sizes of the cities and provinces and players were allocated according to their place of birth.

Results

The data showed that on average, forwards were heavier (effect size = 0.97) and taller (effect size = 1.56) than the backs. The data also showed that 68% of the Springboks participated in U18 Craven Week between 1988 and 2008 while only 32% of the Springboks gained selection to the SA Schools team. Furthermore, on average, the Springboks participating at U18 Craven Week were taller ($p<0.0001$) and heavier ($p<0.0001$) than the players not selected for the Springboks between 2000 and 2010. The largest cities (> 65 000 people) in South Africa account for 55% of the Springboks in terms of place of birth while 29% of the Springbok players between 2000 and 2010 were born in the Western Cape.

Conclusion

The findings of this study suggest that U18 Craven Week is an important factor for achieving success in South African rugby union as increased stature and mass at U18 is associated with success in South African rugby union. However, in terms of talent development, U18 Craven Week may be too late in the maturation process. There is no clear pathway to becoming a Springbok and future research in this area is necessary in developing a talent identification and development model for South African rugby union.

CHAPTER 1:

Introduction and scope of the thesis

Sport has developed into an industry allowing many individuals to pursue a career as a professional athlete[1,2,3]. However, the majority of participants in sport never go on to reach the elite sporting level and thus do not become professionals[4]. For example, in the United States of America (USA) only 1643 football players play in the National Football League (NFL) while there are 2 867 000 youth participants (6-17 years old)[4]. Therefore, only 0.09% of high school football players become professional football players when they are older, while only 2.0% of college football players make the transition from college football to the NFL[4].

Several sporting bodies around the world have adopted the strategy of implementing talent identification and development programmes[5,6,7,8,9]. The aim of these programmes is to identify talented individuals early and place them in programmes which are designed to promote and accelerate their development. A successful talent identification and development programme would ideally increase the chances of converting a young athlete into an elite athlete. However, the process of talent identification is complex as individuals do not develop at the same rate and selection into the programme is often based on current performance, before maturation is complete[10,11]. This has resulted in several authors suggesting that it is not important to be included in talent identification and development programmes from an early age[12,13,14].

In recent times, there has been a great debate surrounding the question: Are champions born or made? The theory of deliberate practice proposed by Ericsson implies that athletes (in the general sense) achieve success through several hours of deliberate practice and that any individual, within reason, can achieve sporting excellence if they train sufficiently[15]. Ericsson has gone as far as to suggest that 10 000 hours/10 years of deliberate practice needs to be accumulated before an athlete can achieve expert levels. In contrast, several authors propose that genetics has an influence on elite sporting performance suggesting that some athletes have the genetic predisposition to be successful in

sport[14,16,17]. Recently, Tucker and Collins had a more pragmatic approach and argued that elite sporting performance is the result of the interaction of genetic and training factors[17].

Sport is an integral part of the culture in South Africa and the country has a rich sporting history[18]. Over the years, many South Africans represented the country admirably and with pride in various sporting codes ranging from rugby union to cricket[18]. In recent times, the South African cricket team (the Proteas) have reached the pinnacle of Test cricket and are currently (February, 2013) the number one ranked team in world cricket[19]. In addition, within their ranks they have three of the top ten batsmen and three of the top ten bowlers in world cricket[20].The South African national football team (Bafana Bafana) won the African Cup of Nations in 1996 and hosted the FIFA World Cup in 2010. Recently, they exited the 2013 African Cup of Nations in the quarter finals after a defeat to Mali[21]. Furthermore, at the London Olympics (2012), team South Africa performed admirably and collected 6 medals (including 3 gold)[22]. Rugby Union is a popular sporting code in South Africa and the national rugby team (Springboks) have won two World Cups (1995 and 2007)[23,24]. For the purpose of talent identification and development in different sports, it is interesting to see how each individual achieved elite sporting excellence. Which factors contributed to the success of these individuals in their quest for sporting excellence? What were the pathways that led to their sporting success? Did they all follow the same pathway or are there different pathways which may lead to success?

This question is particularly relevant to rugby union in South Africa where the Springboks, have in the last 10 years hovered between 1st and 6th rank in the world[25]. Although the national team consistently performs well, there is concern that not all the talent evident at the age groups levels matures fully. This has created the impression that the sport is not transforming, because the representative teams at the various age groups usually reflect the demographics of the population, whereas the national senior team does not[26] . As a result the administrators and coaches are criticised for the lack of transformation in the game[26]. Therefore the question "*what are the factors that are associated with success in South African Rugby Union*?" is an important question. Also, by identifying factors associated with success in South African Rugby Union, the process of talent identification and development may be enhanced in the country.

In South African Rugby Union, the model of talent identification revolves around competition at various age groups (U13, U16, and U18)[27]. A study showed that only a small number of U13 rugby players participating at Craven Week progress to be talented players at the U16 and U18 levels[27]. The reasons for this are twofold. Firstly, the factors associated with success at U13 level are different to the factors associated with success at the U16 and U18 level. Alternatively, the physical characteristics of the talented U13 players, which defined their success at that level, changed as they grew and matured[27]. Therefore the use of these tournaments, especially the U13 tournament, for the purpose of talent identification is short-sighted and may lead to the exclusion of those players that are talented from a skill perspective, but only mature later.

In conclusion, South African Rugby Union is in need of a talent identification and development model that considers the factors that are associated with success at the senior level. These factors include, but are not limited to physical attributes and skill. The other aspects such as playing history (including school, geographical region and size of city in which the player developed), while important had not been described. Therefore the aim of this study is to describe the characteristics (physical and biographical) of rugby players who have achieved success at the highest level in the country to determine whether there are common features which can be incorporated into the development of young players. The findings of this study will have practical applications for talent identification and development in South African Rugby Union.

The study will be conducted in 2 parts. The first part (Chapter 2) will be a review of the literature on talent identification and development, in particular the various models which have been described in sport. The second part (Chapter 3) will describe the analysis of data of the players who have performed at the level of the national team. The context of the study and summary and conclusions will be discussed in Chapter 4.

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CHAPTER 2:

Literature Review - Talent Identification and Development

Introduction

Talent is defined as a "*marked innate ability or a natural endowment of a superior quality*"[1]. According to Howe et al, talent is relatively domain-specific and several properties have been assigned to their definition of talent[2]. For example, they summarise that; (1) Talent has a genetic component and therefore not all individuals possess talent. (2) Individuals may possess talent in some but not all domains. (3) Early identification of talent provides a basis from which to predict who will most likely develop into exceptional individuals. (4) Although talent may not be expressed at a young age, an experienced coach should be able to identify whether a young individual has talent or not [2].

Due to the professionalism of sport, the implementation of talent identification programmes has become increasingly important to numerous sporting bodies and organisations[3]. Often the aforementioned sporting bodies and organisations adopt an approach of identifying talent at an early stage with the aim of developing and nurturing those talented individuals as they grow and mature. For the purpose of this review, talent identification is defined as the recognition of talent within a given sporting code or codes[4]. As talent is multifaceted and dynamic in nature, there are several components that influence an individual and the development of that individual. The components that will be discussed in this review include genetics, growth and maturation, performance components, and psychological characteristics[3,5,6,7,8].

Talent Identification and Development –definitions

Talent identification is a process that typically occurs during the periods of childhood and/or adolescence. Childhood is defined as the period from the age of 6 years through to the onset of adolescence or the period during which most bodily systems mature structurally and functionally[4].

Individuals develop and mature at different rates which make the process of talent identification and development quite complex[3].

Talent development can be described as the provision of the most appropriate environment in which to realise the talent that has been identified. Similar to talent identification, talent development is seen as a complex interaction of various components which directly influence an individual's opportunities and progression in a sport[9]. Talent development is a process rather than an event and therefore cannot be based on specific outcomes such as selection to a junior representative team or obtaining specific scores on tests. Many individuals may reach the same end point in terms of performance, but their path to that end point does not have to be generic. The path to success differs from individual to individual as shown by Elferick-Gemser in a study on elite and sub-elite youth field hockey players aged between 12 and 19 years[10]. Even though this study showed that elite youth hockey players showed better development patterns than the sub-elite, individual differences were still present in the elite group.

Within the field of talent identification and development, there is an ongoing debate about the contribution of nature and nurture to the manifestation of talent. However, there is no clear scientific evidence that nature is more important than nurture or the other way around for that matter. A recent review by Collins and Tucker, concludes that elite sporting performance is determined by an interaction between genetic and training factors[8]. It is suggested that elite sporting performance occurs as a result of the exposure of an inherently talented individual to the appropriate combination of extrinsic factors[11]. Therefore, there is merit in considering the response to training when discussing talent identification and development. This is in contrast to the model of Ericsson which proposes that deliberate practice of at least 10000 hours leads to the achievement of elite sporting performance[12]. However, these recommendations were based on a study done on violin players and not on sporting performance and fails to account for the differences in performances achieved by those individuals who have accumulated the necessary amount of hours of deliberate practice.

Factors that influence talent identification and development

Genetics and physical characteristics

Genetics, along with measures such as stature, mass, and aerobic capacity have traditionally been used to identify talent, however, due to the multifaceted and complex nature of sport, the accuracy of these methods are questionable[3,13]. The role of these factors along with several others will be discussed below in relation to talent identification and development.

The genetic makeup of an individual contributes to the sporting success of an individual. However, due to the complexity of the genetic makeup of human beings, it is virtually impossible to pinpoint the exact gene that is associated with various aspects of elite sporting performance. In addition, it is highly unlikely that only one gene contributes to an individual's sporting performance[8]. For example, sex, stature, aerobic capacity, and skeletal muscle properties are inherited traits that have been associated with performance[8,14]. Genetics will be further discussed in relation to other components of talent identification and development later on in this review.

Stature

Stature is an important characteristic for success in certain sports (e.g. rowing, basketball) and playing positions within certain sports[15,16,17]. For example, in rugby union, lock forwards competing at an international level are expected to be about 1.97 m[18]. The relevance of stature in identifying talent is sport-specific and is affected by maturation as individuals grow at different rates. The increase in stature with growth occurs as a result of changes in the hormonal activity during maturation and consequently stature is linked to levels of maturity[3]. Growth typically consists of an acceleration phase coinciding with puberty, followed by a deceleration phase and subsequently the cessation of growth due to closure of the epiphyses. Peak height velocity (PHV) is defined as the maximum rate of growth in stature during the growth spurt while the age of maximum velocity of growth is called the age at PHV[4]. PHV is useful in characterizing the growth spurt. Although PHV can be defined accurately, and adult stature can be predicted from this, a relatively large amount of variability exists

(SEE = 4.2cm) with the prediction[19,20]. Therefore stature has limitations as a means of identifying talent in prepubescent individuals[4,21].

Body mass

Mass has been shown to be associated with success in rugby union at the elite level[22]. Therefore, it may be an important factor to consider in terms of talent identification and development. Approximately 40% of the increase in mass in males during adolescence can be attributed to hormonal changes within the body[3]. However, due to the increased levels of physical inactivity that is prevalent among adolescents, fat mass may also increase. Weight gain as a result of increased fat mass is not advantageous, particularly when success in the physical activity is dependent on endurance, strength, power and speed. Therefore, the association between increased body mass, as a result of increased fat, and talent identification may be questionable[23]. Furthermore, body mass as a means of talent identification, may be inaccurate because it may potentially underpin attributes such as speed, power, and strength. This results in heavier individuals being favoured instead of lighter and possibly more skilful players[24]. Durandt et al suggests that the capacity to increase mass during adolescence is important as the body undergoes several growth and maturation processes[25]. Often the differences that exist in adolescent mass are not significant once those individuals reach adulthood. This therefore casts doubt on the practice of using mass at adolescent as a means of predicting mass at the onset of adulthood[3].

The composition of the individual's mass is of interest as well when considering talent identification and development. As explained above, the mass and stature of an individual before puberty does not provide complete information about how the person will develop as an adult. A large proportion of growth during adolescence can be attributed to increased muscle mass. Individuals that mature early have a higher proportion of muscle mass in comparison to similarly aged individuals that mature later. This difference in muscle mass is not present during adulthood, suggesting that muscle mass during adolescence is a poor indicator of subsequent adult talent[3,26].

Muscular strength

Muscular strength, an important component of performance in many types of sports, is associated with several factors including muscle mass. Strength can be modified via specific training, nutrition and drugs and therefore measuring strength during adolescent and predicting how it will manifest as the person matures is not practical[3]. Of note is the fact that body fat along with muscle mass are modifiable components and can be manipulated with nutrition and physical activity regardless of it having a genetic component[13]. It can be said that since they are modifiable components, their ability to influence talent identification should be minimal as individuals who possess the necessary attributes to excel may manipulate these components to their favour.

Aerobic capacity

Aerobic capacity is often associated with endurance performance in adults[27] . In comparison with adults, children and adolescents have a lower absolute oxygen uptake but a higher relative oxygen uptake values. Consequently, children and adolescents have different physiological responses to exercise[27,28,29,30]. During growth and development of adolescents, improvements in aerobic capacity occur. Peak improvements in aerobic capacity occur around the age associated with PHV and peak weight velocity. Therefore, the measurement of aerobic capacity during childhood and adolescence does not serve much purpose from a talent identification perspective. This view is supported by a study on young soccer players, which showed no significant differences in aerobic capacity between successful and unsuccessful players. The authors of this study concluded that provision should be made for late maturers in terms of talent identification[31].

Personality

Although much research has attempted to identify personality profiles for elite athletes, there have not been any conclusive outcomes[6,13] suffice to say that psychological determinants allow athletes to maintain high levels of performance on a consistent basis resulting in a successful career[6,13]. Examples of psychological factors which would likely influence talent identification and development include

decision-making, goal setting, self-confidence, and motivation, to name a few. These examples are all specific outcomes associated with success in many sports. But, because there are a variety of factors that influence a successful outcome it makes it hard to predict with any accuracy the effect of the aforementioned psychological factors[6,13,32,33]. More recently, the role of emotional intelligence in performance has been investigated and it was found that the emotional intelligence was positively related to performance in the Supersport Series (Premier 4 day cricket competition in South Africa)[34]. An association was found between the final rankings of the teams that competed and the teams' emotional intelligence scores with the team winning the competition scoring the most. This along with the role of emotional intelligence of the coaches involved in talent identification and development warrants further research as it may be a useful predictor of talent and has implications on the development of talented individuals[34,35].

Early identification and specialization

There is a popular theory that early identification of talent and consequent specialization in a sport leads to elite sporting success.[36,37] This has resulted in sporting bodies, various other stakeholders, the government and parents investing money and other resources into sport with the goal of developing talent and the development of athletes[8,37]. The sporting industry has grown and there are greater rewards for successful professional athletes. School and College scholarships, professional contracts, and endorsements are just some of the incentives for young athletes and all those involved[37,38]. Successful young athletes have become lucrative for their parents[38], perhaps explaining why some parents are so motivated for the talent of their children to be recognized. However, the approach of early identification of talent has been questioned and several issues have been raised about the negative effects of early specialization[36,37,38,39,40]. For example, early identification and specialization may lead to the exclusion of individuals that mature late as they are overlooked for those that mature early. Those individuals labelled as talented at an early stage often get exposure to better coaching and participate in competitions against other "talented" individuals[37,38]. Thus, the gap between those identified early and the rest of the children may increase over time. This leads to the exclusion of those individuals who are not seen as talented at an early age or who may have not yet matured[37,38].

Furthermore, this approach of early identification and specialization may lead the individual to becoming susceptible to overuse injuries[37,41,42].

The relative age effect

In many sports children are grouped into 12 month age categories according to chronological age[24]. Therefore in any given group some individuals may be born at the beginning of the period (i.e. January) while others may be born almost 12 months later towards the end of the cut off period. In the younger age groups the development that can occur in 12 months may be quite significant. At a young age the individuals in the group born at the beginning of the cycle have a potentially greater opportunity to develop compared to those born towards the end of the cycle. Indeed, there are many examples of sports teams with players who have an over-expression of birthdates in the first four months of the year compared to the last four months. This is known as the relative age effect[43]. The relative age effect is present in sports which have strong competition at a young age such as football and ice hockey[24,43]. Furthermore, the relative age effect is evident in sports in which greater physical development provides a performance advantage[43]. This is supported by a study which showed that older individuals within an age-group were more likely to gain selection as opposed to the younger individuals and that the older individuals were more likely to be retained through to senior level[43,44]. In another study conducted on youth soccer players in Spain it was found that a significant percentage of the players were born in the early months of the year, this study included soccer players from elite and amateur backgrounds[45]. This is especially important when the individual is recruited[45]. The earlier an individual is recruited, the greater that individual's exposure is to better coaching and better opportunities[24,37,44,46,47]. This potentially facilitates the development of the selected individuals while it also ensures that the late maturers have an even harder task of catching up. Thus, talented age-disadvantaged (early maturers) players may be lost to the game as they may drop out and participate in another sport[43].

The role of competition in talent identification and development

Competition is an important component of any talent identification and development model and facilitates growth by providing athletes with the platform to gain experience. Competition encourages teams and individuals to test their skills against peers and is seen as a key component of development[48]. Many sporting bodies and people involved in talent identification use the platform created by competition to discover talented individuals with potential to develop into high level athletes[8,36,47,49]. However, the ratio of competition to training is important and needs to account for maturation of participants while also addressing the need for participants to be exposed to competition.

Young athletes often find themselves under pressure to perform well in competition to gain selection into representative age group teams that compete at a higher level. This pressure comes from parents, coaches, teammates, and themselves. There are two points to consider about competition for young athletes. Firstly, adult competition structures are often imposed upon junior competitions[49] . This approach often emphasises winning which adds to the pressure of the developing athlete. Secondly, junior competitions are structured according to chronological age and fail to account for maturation[24]. Selection of individuals to compete in these competitions may serve to exclude talent rather than promote the development of talented individuals. For example, late maturers who possess the skill set to be successful may be overlooked and not given the opportunity to further develop in the sport. This may result in them choosing to play another sport in which size is not such a prerequisite for success[50]. These points have been discussed under the relative age effect above.

The role of birth place

The size of the city in which an individual is born has been associated with early exposure to sport[51]. This is supported by a study which investigated the "birthplace effect" across 4 major sports in the United States of America[51]. The study looked at the birthplace of all the players participating in the following leagues, National Hockey League (ice hockey), National Basketball Association (basketball), Major League Baseball (baseball), and the Professional Golfers' Association (golf). The

odds ratio for becoming a professional athlete in all of those leagues increases as the population of the city of birth decreased[51]. This study suggests that smaller cities provide greater early opportunities and exposure for talent development than larger cities. It may be assumed that smaller cities provide individuals with a different sporting environment to that of a larger, urban city. The environment in a smaller city is less structured and allows individuals to be exposed to different sports and they are more likely to engage with others of different ages and sizes. In contrast, larger cities tend to have more structure resulting in specified practices and matches against individuals of the same age, size, and ability[51]. However, individuals from smaller cities have fewer options in terms of resources available to them while individuals from larger cities tend to have access to a variety of resources. For example, resources such as specialised coaching, facilities, and equipment may be more available in an urban setting rather than a smaller city[51,52]. Therefore, the talent identification and development model should ideally be specific to the environment in which it is to be implemented.

Models of talent identification and development

Various frameworks have been developed within sports to facilitate the process of talent identification and development. For example, the Long Term Athlete Development (LTAD) model, the Differentiated Model of Giftedness and Talent (DMGT), and the Developmental Model of Sport Participation (DMSP) are examples of a systematic approach to developing talent. Each model focuses on a different aspect of talent. The relevance of these models is based on their apparent ability to promote the identification of talented individuals and facilitate their development. This is important to all sporting bodies as in theory it enables them to identify and develop more individuals who have an increased likelihood of attaining success. In the following section, some of the existing models will be discussed with particular focus on the LTAD model as it has been implemented by several sporting bodies around the world, including the United Kingdom, South Africa, United States of America, and Canada[53,54,55,56].

LTAD model

The LTAD model was pioneered by Dr Istvan Balyi of Canada and comprises seven stages which account for the physical, mental, emotional, and cognitive development of children and adolescents[4,7]. Maturation levels are central to the model rather than chronological age. Chronological age represents the number of years and days elapsed since birth, while maturation or biological maturity is defined as the qualitative functional and structural system changes within the body[4]. The LTAD model is aimed at developing participants in general rather than identifying talented individuals at an early stage.

The stages of the LTAD are displayed in figure 1 and encompass the development of an athlete from birth through adolescence and into adulthood while also emphasizing staying active for life. Physical literacy (competency in fundamental motor and sport skills) and sport is encouraged for all during the first 3 stages of the LTAD model and this is followed by three stages during which the attainment of excellence is developed. Life-long physical activity is encouraged throughout the LTAD model[4].

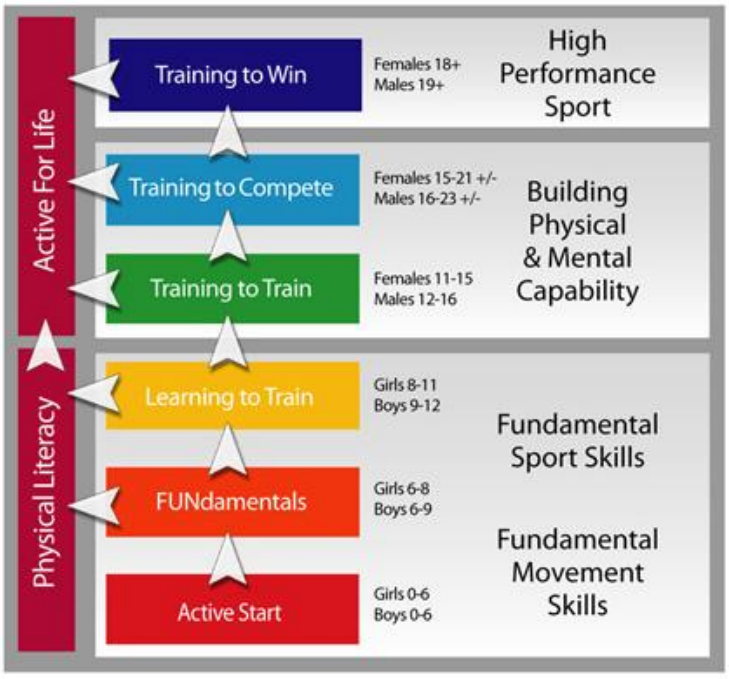

Figure 1. LTAD Model (reproduced from Balyi et al[4], with permission from Canadian Sport for Life)

A strength of this model is that it considers the entire career of an athlete, with each stage attending to a specific period of development. The aim of the model is to ensure that a strong foundation is laid for

life-long participation in physical activity. In addition, the model provides athletes with guidelines for optimal training, competition and recovery programs. LTAD structures competition and tournaments to promote growth and development at different stages. The role of competition in talent identification and development has been discussed earlier in this review. The LTAD is an integrative model that is inclusive of all athletes, coaches and parents. There is also input from various sectors including sports science specialists and government[8,55].

According to the model, sports are classified as either early or late specialization sports. Team sports, are predominantly classified as late specialization sports (e.g. Rugby Union). This allows for participants who develop late to be included and it facilitates the development of all participants instead of excluding them at an early stage. Of particular importance is that the LTAD model considers the development of disabled individuals and integrates them into the model with disabled sports falling into the late specialization category. In addition, there are many documents published on the Canadian Sport for Life website (www.canadiansportforlife.ca) regarding disabled sport. Several sporting bodies have adapted the LTAD model to be sport-specific. For example, Cricket South Africa[57], the Australian Rugby Union[58], and various sport codes in the United Kingdom[53] have modified the concept of the LTAD model to fit the demands of the sports.

A recent review highlights several limitations in the LTAD model especially in relation to claims made by the model in terms of physical literacy, aerobic and anaerobic performance[40]. Ford et al also suggest that there is a lack of individuality with the LTAD model due to the age groups and that more scientific research should be conducted to substantiate the claims made by the model. Another criticism of the LTAD model is that coaches interpret it differently and base their coaching methods on the inappropriate interpretations[59,60]. It has been proposed that coaches and practitioners get better education about the implementation of the model to enhance the development of the individuals with whom they are working with[60]. As the LTAD model was developed in Canada, it does not consider factors that a developing country such as South Africa is exposed to. For example, there are differences in children from different socio economic groups with regards to physical fitness. Thus, an LTAD model in South Africa would have to account for that[61].

The LTAD model is a solid framework for the promotion of life-long physical activity, achieving this via integration of many factors including physical and mental attributes. The key to LTAD is that it is based on maturation levels of individuals. It incorporates paediatric exercise science, exercise physiology, sport psychology, nutrition, and the experiences of athletes and coaches. As pointed out earlier it is not designed to necessarily identify talent.

Differentiated Model of Giftedness and Talent (DMGT)

The Differentiated Model of Giftedness and Talent (DMGT) is a model proposed by Gagne[62]. This model is based on the premise that a distinction exists between giftedness and talent. The definition of talent in this model is: "*the outstanding mastery of systematically developed abilities, called competencies (knowledge and skills), in at least one field of human activity to a degree that places an individual at least among the top 10% of age peers who are or have been active in that field*"[62]. The DMGT model is similar to the LTAD model in that it involves talent development. It begins with the identification of "natural abilities", which place an individual in the top 10% of the group in question, and it is proposed that environmental and intrapersonal factors proceed to influence the developmental process, resulting in a talented individual. The "natural abilities" identified in this model span four domains, namely: intellectual (reasoning and judgement), creative (problem-solving), socioaffective (influence, intelligence and communication), and sensorimotor (senses, muscular strength, etc.) leading theoretically to talented individuals in fields ranging from sport and technology to academics[9].

The DMGT accounts for the multifaceted nature of sport by integrating all these domains into a holistic approach. The model assumes that attributes such as decision-making and temperament need to be developed just as much as physical attributes like strength and speed. An individual's capacity to learn and develop is central to the DMGT. Furthermore the model recognizes that the developmental process may be positively or negatively influenced due to its interactions with various factors[9,29,62]. For example, the environment may influence an individual's development. The DMGT is not sport-specific and therefore needs to be adapted to be used to identify and develop individuals within team

sports. The stages within the model are not clearly identified and therefore it may be problematic to assess the developmental progress of an individual.

Bloom's model

Another model of talent development is Bloom's model[6]. Progression through this model is dependent on the completion of certain events and tasks along the developmental process, rather than in accordance with chronological age. In the first stage, fundamental skills are developed and participation is encouraged[6]. A relaxed environment is created in which children can have fun and any special abilities possessed may come to the fore. Competition is de-emphasized during this stage. Stage two is associated with adolescence and an increased rate of development and subsequent talent identification[6]. There is a greater emphasis on results and achievements during this stage compared to the first stage. Stage three is the stage in which the individual strives for perfection. The chosen sport is now seen as a priority and nothing less than the highest level of performance is expected. In stage three, the individual is largely responsible for his or her own success and relies to a lesser extent on coaches and parents, compared to the initial stages where the individual depended more on the parents and coaches for guidance and support[6].

Bloom's model is tailor made for the identification and development of talented individuals, especially in individual sports such as tennis. However, there is less evidence that model may be applied to team sports. The fact that the model is not guided by chronological age is a strong point. However, the model does not acknowledge the role of culture as it was developed for the North American population which differs significantly from the South African population. Also a great emphasis is placed on the role of the coach, which may lead to the individual relying heavily on the support structures.

Developmental Model of Sport Participation (DMSP)

Côté's Developmental Model of Sport Participation (DMSP) is an extension of Bloom's model[55]. The model is orientated towards the psychological aspects of development. Côté identifies three stages, namely; the sampling phase, the specialising phase, and the investment phases which are similar in concept to the phases in Bloom's model[6,55]. In the DMSP, participants move from stage to stage depending on the decisions they make instead of any age or maturation category. A key distinction made in this model is between deliberate play and deliberate practice. Deliberate play is seen as activity that is designed to promote enjoyment and build fundamental skills while deliberate practice is an activity aimed at improving performance[55]. It is evident from this model that deliberate practice is more prominent later when the participant wants to compete and attain a high level of performance. The model describes this as the investment phase.

Bailey and Morley's Model of Talent Development

Bailey and Morley's Model of Talent Development is based on research conducted into the talent development processes in school physical education and this model consists of three major hypotheses[55]. The first hypothesis suggests that current performance is a poor indicator of talent as it is influenced by several factors including training and parental investment while the second hypothesis states that development is multidimensional. The third hypothesis emphasises that practice is important in the development and realisation of talent and deliberate practice is important in high level performance[55].

Summary

Based on the discussion of the LTAD, DMGT, DMSP and Bailey and Morley's Model of Talent Development, it is clear that an all-encompassing model for talent identification and development does not exist. This can be attributed to the multi-factorial nature of talent that makes it virtually impossible to identify talented individuals with 100% accuracy. However, the process of talent identification and development is a key area in which more research needs to be conducted with the

ultimate goal of developing a model which is based on sound scientific research and accounts for all the factors influencing talent. The next section of this review will focus on rugby union in general and in particular the talent identification programmes that exist in this sport.

Rugby Union

Rugby is a team sport characterised by bouts of high intensity, short duration activity. Players often collide exposing the body to various physical stresses resulting in a relatively short lifespan within the sport[63,64]. The physical attributes of rugby union players are diverse which is in accordance with the fact that rugby union comprises a variety of player positions, each with different demands. Players with specific physical characteristics are more likely to play in certain positions because of the contrasting demands of the various positions[63,65,66]. The diversity present in positions and physical attributes associated with the different positions make talent identification and development hard to achieve.

Rugby Union is popular in South Africa and has 472 915 participants of various ages and skill levels with some playing rugby for fun while others play rugby as a profession[50]. There are several formats of Rugby Union that are played in South Africa including Touch, TAG, Sevens, and Bulletjie rugby to name but a few. However, the most popular format is that of 15 man rugby and from a very young age, many schools and clubs play this format. Not much research has been done in terms of developing a talent identification and development model for rugby in South Africa. The current structure assumes that most of the talented players will be identified at national tournaments. For example, national age group tournaments such as Craven week (under 13 and 18), Grant Khomo (under 16) and the Academy week (under 18) serve as the pool from which talent is identified and developed. In contrast to this approach, the RFU (Governing Body of Rugby Union in England) have outlined a plan aimed at integrating all levels of rugby in England, including the support staff[67]. The program was constructed to develop all role players to an elite level over time and ensure that the pool of quality individuals coming through the system is maintained. Of note is the fact that special emphasis is placed on the monitoring of players outside of the clubs and academies. This is because

the RFU has acknowledged that players can develop or mature late and as a consequence may have been excluded[67]. The proposed plan was aimed at winning the 2011 Rugby World Cup (RWC) as well as the 2015 event. The plan acknowledges that talent may exist outside their structures and scouts are sent out to look for talent by exploring other avenues[67].

The New Zealand Rugby Union has also adopted a player development model and has titled it: *From Small Blacks to All Blacks*[68] while the Irish Rugby Union adopted a model titled: *From 6 to 6 Nations*[54]. These models all promote participation and development from a young age all the way through to adulthood with the goal being high-level performance as well as enjoyment at all levels of participation. It is evident that the "tournament based approach" of identifying talent adopted in South African rugby is not best practice.

The U13 Craven Week tournament promotes this format of the game from a young age as provincial teams are selected to participate in this tournament. Also, many participants who make the provincial teams at U13 Craven Week go on to attend schools that have a rich rugby playing heritage and may have been offered scholarships from being exposed at Craven Week. High School rugby is competitive in South Africa with 148 779 participants[50]. Top schools in the country compete against each other in a nationally televised competition, the FNB Classic Clashes. Top players in each region are selected for provincial teams for both the U16 (Grant Khomo) and U18 Craven Week tournaments. These tournaments serve as the platform for the players to showcase their skills and talents. Talent scouts go the tournaments and players that show potential, particularly at the U18 tournament are often given provincial contracts. At the end of U18 Craven Week, a SA School side is selected. This team plays a match against the SA Academy side which is selected at the end of the U18 Academy Week. The Academy Week is similar to Craven Week and occurs a week prior to the U18 Craven Week. From Craven Week, players filter through the system into various teams competing in the Varsity Cup and Varsity Shield as well as the Vodacom Cup while the SA U20 team (also known as the Baby Boks) participate in the IRB Junior World Championships every year. In addition, there is a provincial U20 tournament. The best players in the country are signed up by franchises to participate in the Super 15 (n=166) while thereafter they represent provincial outfits in

both the Currie Cup Premier (n=507) and First Divisions (n=524)[69]. Nowadays, as rugby has become a career for more individuals, overseas contracts have become attractive with many players signing with teams in England and France with some of these players even going on to represent those nations at international level. Sevens rugby is also very popular in South Africa and promotes young rugby players and their subsequent development. Some Springbok players have played Sevens rugby prior to their success in the 15 man game.

Conclusion

Talent is dynamic in nature. Many factors such as a person's maturation and their interactions individuals with the environment need to be considered in any model. The role that culture plays in the process should not be omitted from future models and sport in South Africa would benefit substantially from the implementation of a model leading to the expansion of the pool of players competing and performing at an elite level. Therefore, a model addressing physical, mental, and cognitive factors as well as the maturation process could possibly benefit sport in South Africa; however, the model would have to be sport-specific for it to be implemented within the various sport codes. The need for a talent identification and development model for rugby union is evident as the existing models are limited. The next section will examine the factors that are associated with success at the senior level in South African rugby union.

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CHAPTER 3:

Factors Associated with Success in South African Rugby Union

Introduction

As mentioned in the previous chapter, rugby union is a popular sporting code in South Africa with the national team (Springboks) having won the IRB Rugby World cup on two occasions (1995 and 2007). The development of talent has been dependent on having competitive and well-structured school leagues around the country. Talented players are selected for their provincial age group teams which compete at national tournaments at the age of 13 years (Craven Week), 16 years (Grant Khomo Week) and 18 years (Craven Week and Academy Week). Craven Week (18 years) is the premier age group competition in the country and showcases the best rugby players in the country culminating in the selection of the South African Schools team. This team is representative of the best players at the U18 Craven Week and it is expected that these players will become successful adult players. Talent scouts representing provincial unions observe players at the tournaments[1]. They subjectively identify talent and make recommendations to provincial unions to offer contracts to these players. However, this model of talent identification and development has flaws. Firstly, the pool of players from which to select has diminished in recent times, especially in comparison to that of rivals New Zealand and Australia[2]. Secondly, the transfer of talent from the younger age groups to the older age groups is poor. For example, only 32% of players selected at the under 13 tournament were selected to play at the under 16 tournament and only 24% went on to participate in the under 18 Craven Week[3]. This finding shows that early selection is not the most effective form of talent identification and development.

Furthermore, the South African Rugby Union has implemented several talent identification and development programmes aimed at promoting rugby and developing talent in previously disadvantaged areas. Programmes such as the Nike All Stars programme (1999-2002) as well as the

Spoornet Rugby Excellence programme (1998-2002) have been previously implemented. These programmes were comprehensive and included medical evaluations, physiological testing, strength and conditioning programmes, and training camps for players that were deemed to have talent. In 2002, high performance workshops were introduced to Craven Week with the aim of educating the participants and in essence promoting development. Along with that, the Sports Science Institute of South Africa and SARU launched the Mobile Team Training System (MTTS) to provide weight training equipment for regions which did not have access to training facilities. Since the inception of this programme, 32 units have been distributed around the country[4]. In addition, the South African Rugby Union introduced the Green Squads (2003) which were eventually replaced by the Elite Squads (2007). The aforementioned programmes were aimed at developing and identifying talent, especially of those players in previously disadvantage areas. However, these programmes had limited success at nurturing talent from these targeted areas and are not offered anymore[4].

It is evident that apart from the national age group tournaments there is no clear talent identification and development model currently being implemented in South African rugby. Therefore the aim of this study was to identify factors associated with South African rugby union players who have already achieved success at the highest level. By identifying these factors, sporting bodies and organizations could potentially make better use of their resources in terms of talent identification and development. In particular the results will be important as they will assist rugby unions in South Africa to create an appropriate environment for young players to develop and realise their talent.

Methods

Participants

The rugby players who were selected on debut to represent South Africa on Rugby Union tours and matches between 1 January 2000 and 31 December 2010 were recruited for this study (n=147).

Experimental Design

This study was retrospective in nature and data obtained from individual player profiles were used for analysis. These data were collected from the website of the South African Rugby Union (SARU) (www.sarugby.co.za). The profiles on the website included the following information: player's name and surname, date of birth, school attended, self-reported mass, self-reported stature, self-reported birthplace, and previous playing history which included all the squads that the player had been selected to play for.

Craven Week

In addition, data were obtained from the official match programmes of each under 18 Craven Week from 1987 to 2008. This spanned the era during which the Springboks (2000 to 2010) would have played at the under 18 level. The data from the programmes included self-reported body mass and stature of each player that represented their respective unions at U18 Craven Week.

Population statistics of each city reported as a birthplace by the participants were obtained from the South African Government's Census project (www.statssa.gov.za). In addition, population estimates were obtained for each province.

Statistical Analyses

Descriptive data were analysed using the StatSoft, Inc. (2011) (STATISTICA data analysis software system, version 10. www.statsoft.com). A t-test (GraphPad Prism version 5.00 for Windows, GraphPad Software, San Diego California USA) was used to determine whether or not the differences between the Springbok forwards and backs and between Non-Springboks and Springboks at Craven week were significant ($p<0.05$). The magnitude of these differences was also determined by calculating the effects size[5]. According to this analysis an effect size of <0.2 was regarded as "trivial", 0.2 to 0.5 as "small", 0.5 to 0.8 as "moderate" and > 0.8 as "large". Quintiles were calculated (0-20th, >20th-40th, >40th-60th, >60th-80th, >80th percentiles) for the population sizes of the cities in which the players were born and the provinces in which the birth cities occurred (GraphPad Prism version 5.00 for Windows, GraphPad Software, San Diego California USA). Players were allocated to the appropriate quintile grouping. For the provinces however, the birth cities were allocated to the appropriate province and consequently the players were allocated to the province in which their birth city belonged to.

Results

The number and percentage of players from each rugby union are shown in Table 1. The rugby union was defined as the union the player belonged to at the time of his first selection to a national squad. The Western Province Rugby Union contributed the highest number (n = 25) in the period between 2000 and 2010 followed by the Lions and the Sharks (n = 20 each)

Table 1. Number of Springboks per Union from 2000 to 2010, expressed as a percentage

Province	*n*	*Percentage*
Blue Bulls	18	12
Boland	8	5
Border	5	3
Cheetahs	19	13
Eastern Province	4	3
Falcons	5	3
Griffons	3	2
Griquas	7	5
Leopards	1	1
Lions	20	14
Pumas	7	5
Sharks	20	14
SWD	5	3
Western Province	25	17
Total	147	100

Table 2 shows the number of Springboks in each Super Rugby franchise between the years 2000 and 2010. The franchise indicated in this table is the franchise that the player represented at the time of his initial selection into the national team.

Table 2. Number of Springboks per Super Rugby Franchise, expressed as a percentage

Franchise	*n*	*Percentage*
Bulls	41	28
Stormers	32	22
Sharks	30	21
Cats*	27	19
Cheetahs	13	9
Lions	3	2
Total	146	101#

* in 2007, the Cats split up into the Cheetahs and Lions

rounding

The average stature and mass of the Springboks are shown in Table 3. Forwards are compared to backs with the total average also displayed in the table. As expected, the forwards were taller and heavier than the backs ($p < 0.0001$). The effect size for the differences for mass and stature were 0.97 and 1.56 respectively, both being regarded as a "large" difference.

Table 3. Stature and Mass of Springbok Players (2000-2010), expressed as Mean ± SD

n	*Forwards (n = 80)*	*Backs (n = 66)*	*All Positions (n = 146)*
Stature (cm)	189.1 ± 7.3	181.6 ± 6.1	185.7 ± 7.7
Mass (kg)	110.1 ± 8.0	90.7 ± 7.5	101.4 ± 12.4

Figure 2 shows a breakdown of the Springboks at the level of U18 Craven Week and furthermore how many of these players made the South African schools team. In summary, 68% of the Springboks represented a team at U18 Craven Week between 1988 and 2008 while 46% of these players were selected to play in the SA Schools team. If the entire group (i.e. including players who did not play at Craven week) is considered, only 32% of the Springboks played for the SA Schools team. Another way of interpreting these data is that only 13 players per every 100 players selected to represent the SA Schools team between 1988 and 2008 went on to become Springboks. The SA Schools squad consists of 22 players every year which equates to 440 players over 18 years (1988-2008). Only 46 players of that 440 went on to make their debut for South Africa between 2000 and 2010.

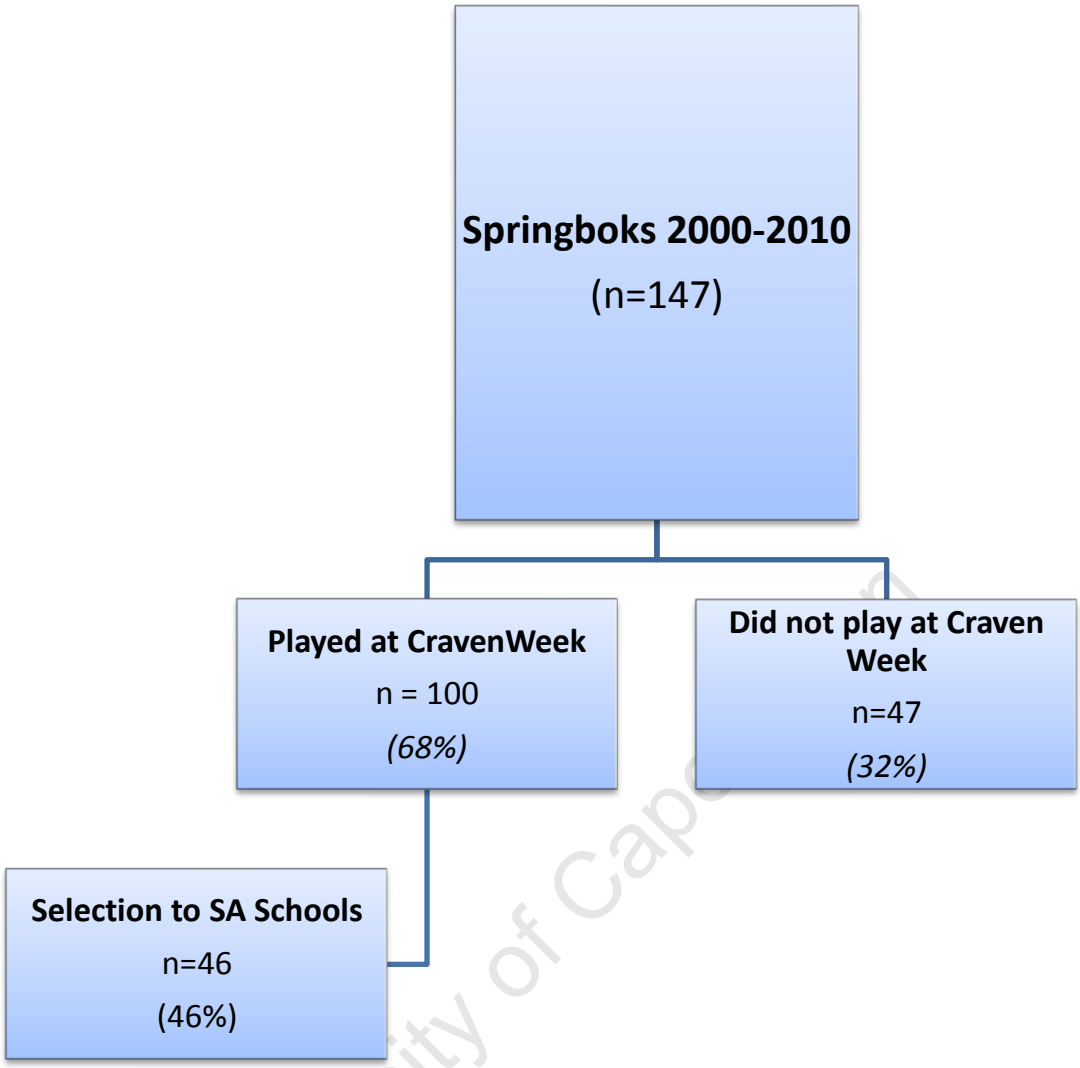

Figure 2. Player Representation of Springboks at U18 Craven Week and subsequent SA Schools selection

Figure 3 is a box and whisker plot comparing average stature and mass of the rugby players at U18 Craven Week between 1988 and 2008. The Springboks at U18 Craven Week were on average heavier ($p < 0.0001$) and taller ($p < 0.0001$) than the players who were not selected for the National Team in the period between 2000 and 2010.

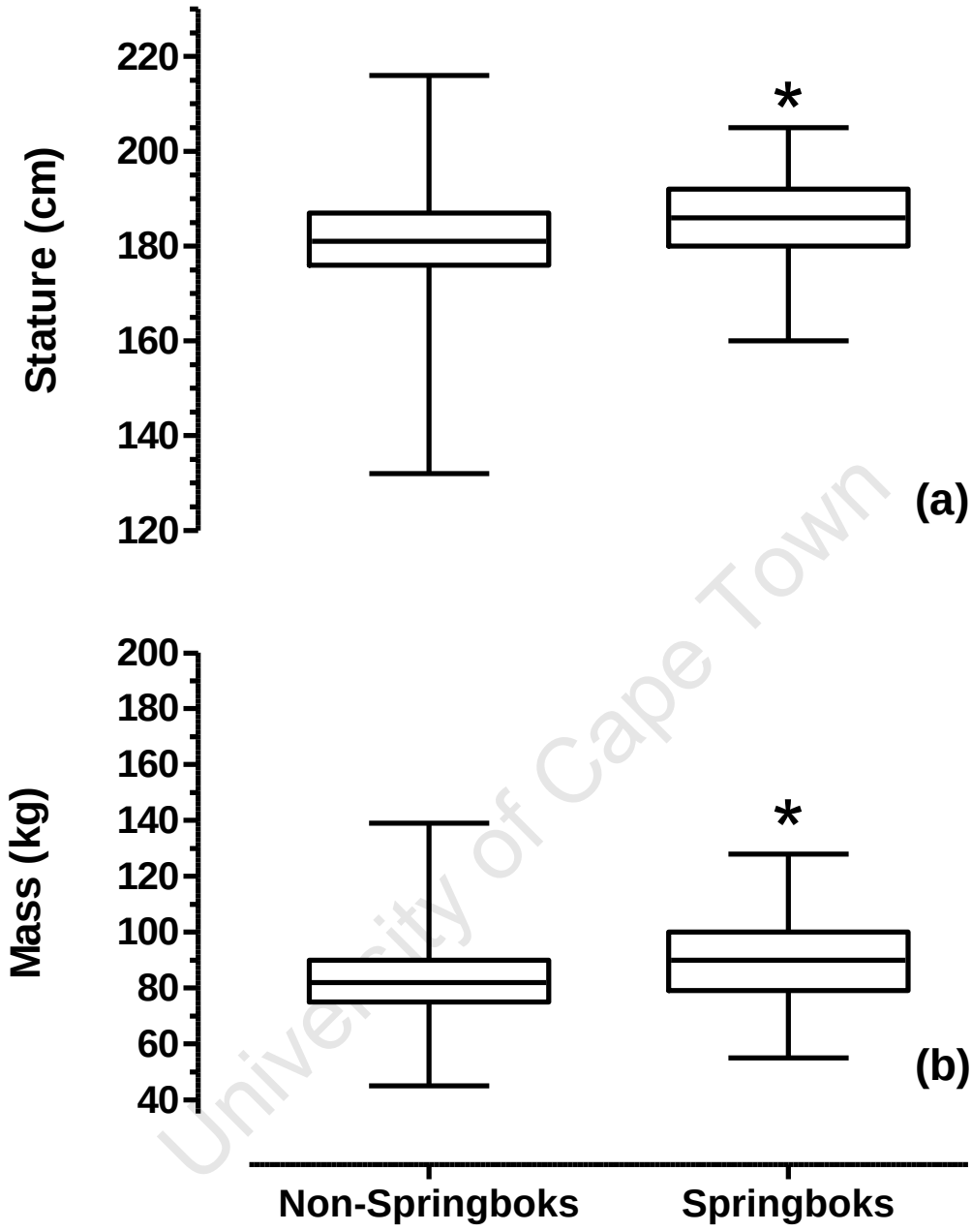

Figure 3. Average stature and mass of players at U18 Craven Week (1988-2008) who became Springboks vs. players at Craven Week who did not become Springboks. The line at the centre of the box represents the mean while the line above it represents the 75th percentile and the line below the mean represents the 25th percentile. The whiskers represent the minimum and maximum values. The asterisk indicates the significance of the difference between the stature and mass of the players that participated at under 18 Craven Week and went on to become Springboks ($p < 0.0001$).

Tables 4 and 5 compare the stature and mass of the players who played at U18 Craven Week and went on to become Springboks to those players at U18 Craven Week who did not become Springboks in the defined period (2000-2010). The Springboks were on average taller and heavier than the Non-Springboks in most of the years. However, these data should be interpreted with caution because of the low number each year and the possibly of a player being selected for a position that is associated with an extreme size (i.e. lock, prop or scrumhalf).

Table 4 Stature (cm) of Non-Springboks and Springboks who played at the Craven week tournament (n = 99) from 1988 to 2008. Data expressed as mean ± SD (or just mean when there was only one player)

Year	*n*	*Non – Springboks*	*n*	*Springboks*
1988	553	181.8 ± 7.8	1	187.0
1990	529	182.2 ± 8.2	1	176.0
1991	586	182.0 ± 8.9	5	185.2 ± 7.1
1992	416	183.0 ± 7.6	1	180.0
1993	482	181.8 ± 8.7	4	181.5 ± 3.7
1994	507	181.8 ± 8.5	8	184.3 ± 11.1
1995	567	181.4 ± 8.5	5	187.6 ± 8.5
1996	613	181.4 ± 9.6	5*	186.4 ± 7.4
1997	637	181.8 ± 8.1	7	183.3 ± 12.2
1998	660	181.8 ± 8.4	14	189.1 ± 10.3
1999	671	181.0 ± 8.2	5	185.2 ± 3.3
2000	669	180.5 ± 8.4	7	180.0 ± 8.4
2001	394	181.5 ± 8.3	5	187.8 ± 12.0
2002	467	181.5 ± 8.1	10	188.1 ± 5.4
2003	395	181.3 ± 8.8	13	189.6 ± 6.2
2004	339	181.5 ± 8.8	4	187.8 ± 4.9
2006	362	181.1 ± 8.2	1	176.0
2007	355	181.7 ± 8.8	1	183.0
2008	436	180.7 ± 7.9	2	177.0 ± 1.4

**data missing for 1 player*

Table 5. Mass (kg) of Non-Springboks and Springboks who played at the Craven week tournament (n = 99) from 1988 to 2008. Data expressed as mean ± SD (or just mean when there was only one player)

Year	*n*	*Non – Springboks*	*n*	*Springboks*
1988	575	81.0 ± 10.0	1	98.0
1990	529	81.7 ± 10.3	1	100.0
1991	586	81.3 ± 11.4	5	85.2 ± 10.6
1992	436	83.1 ± 10.8	1	100.0
1993	502	82.4 ± 11.3	4	83.0 ± 11.5
1994	508	82.8 ± 10.8	8	91.6 ± 14.0
1995	568	82.1 ± 10.4	5	91.8 ± 11.5
1996	613	81.9 ± 12.3	5*	90.7 ± 13.6
1997	637	83.3 ± 11.0	7	91.9 ± 15.6
1998	660	82.9 ± 11.5	14	91.0 ± 15.1
1999	672	82.6 ± 11.4	5	89.0 ± 8.5
2000	673	82.3 ± 11.9	7	80.1 ± 11.4
2001	372	84.9 ± 12.4	5	94.4 ± 11.1
2002	469	84.4 ± 12.0	10	89.4 ± 12.0
2003	395	85.1 ± 12.3	13	92.6 ± 8.7
2004	339	85.9 ± 12.8	4	91.3 ± 4.6
2006	363	85.3 ± 12.1	1	74.0
2007	361	86.2 ± 12.5	1	128.0
2008	439	85.4 ± 12.3	2	86.5 ± 0.7

**data missing for 1 player*

Figure 4 compares the stature (a) and mass (b) of the Springboks at U18 Craven week against the mean of the Non-Springboks for each year between 1988 and 2008. The mean and the 95% confidence intervals are shown for the players who were not selected for the Springbok team. The data for the Springboks are shown as individual data points and are indicated on the graphs. What can be seen is that most of the data points for stature (n = 62) and mass (n = 59) of the Springboks do not fall within the 95% band which further suggests that those players who became Springboks were taller and heavier than their counterparts at U18 Craven Week.

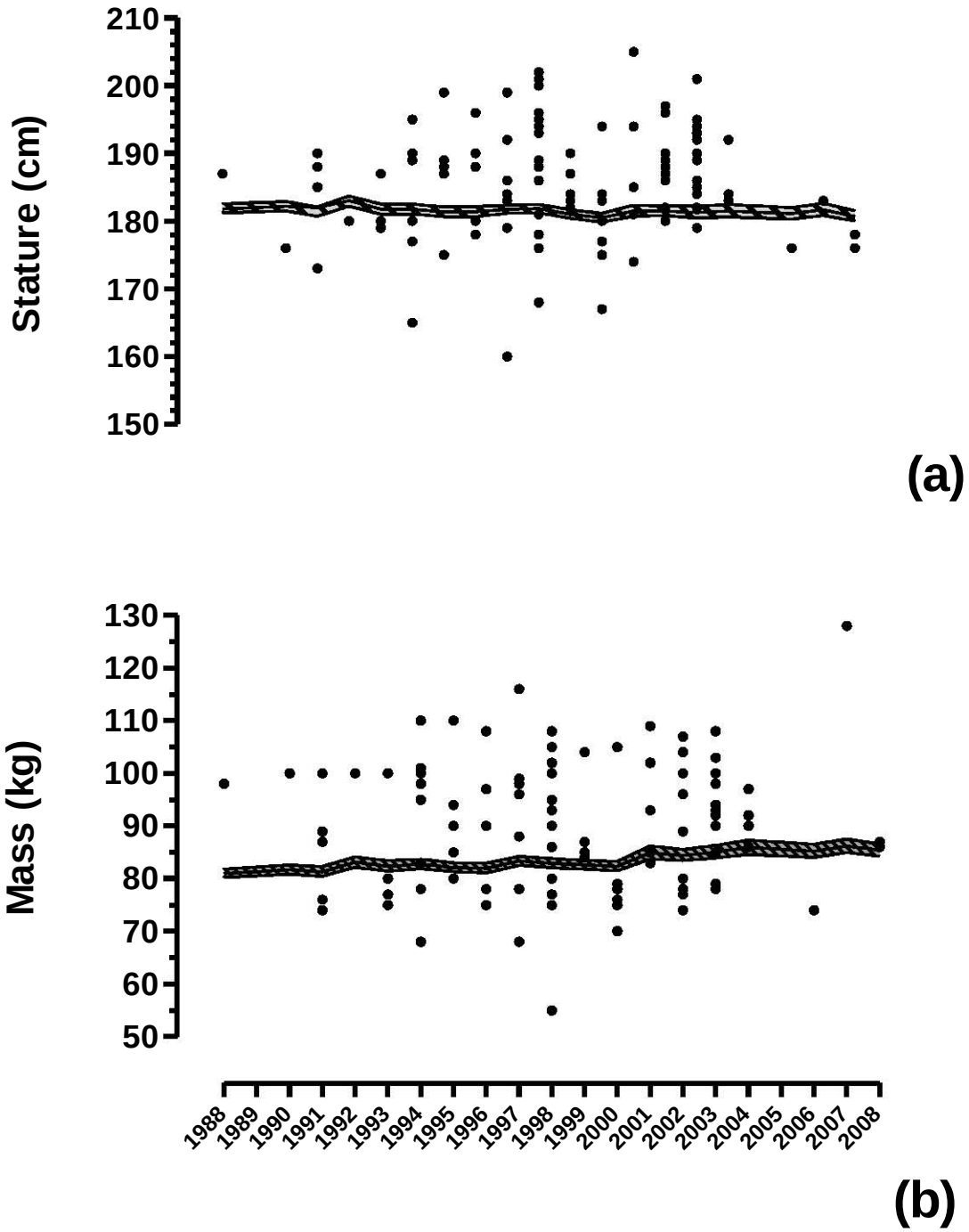

Figure 4. **Springboks Stature (a) and Mass (b) at U18 Craven Week (1988-2008) in comparison to the Mean of the Non-Springboks. The Line represents the average values (with 95% CI) while the dots represent the individual data points of the respective Springbok players**

Table 6 shows the distribution of Springbok rugby players born in cities which have been divided into quintiles ranging from 1 to 5. Quintile 1 represents cities with the lowest populations (less than 8000 people) while quintile 5 represents cities with the largest populations (more than 65000 people). The large cities accounted for most of the Springbok players (55%) and the smallest cities only accounted for 9% of the players (Table 6).

Table 6. Percentage distribution of birthplace of Springbok rugby players divided into quintiles

Quintile Population	*No. of Cities per Quintile*	*n = 135*	*Percentage*
1	57	12	9
2	57	17	13
3	58	14	10
4	58	17	13
5	57	75	55

(1= $<0.8X10^4$ people; 2= $0.8X10^4$-$1.5X10^4$ people; 3= $1.5X10^4$-$2.5X10^4$ people; 4= $2.5X10^4$-$6.5X10^4$ people; 5= $>6.5X10^4$ people)

The distributions of Springbok players' birthplace in the respective provinces are displayed in table 7. The highest percentage (29%) of players was born in the Western Cape which falls in the 3rd quintile in terms of population within the province. While the Free State and Gauteng regions both have a similar percentage (15%) of Springbok players born in those provinces. This is graphically portrayed in figure 4 which shows that the province with the highest percentage (Western Cape; 29%) is not the biggest in terms of geographical size. The biggest province (geographical size) is the Northern Cape in which only 5% of the Springboks between 2000 and 2010 were born. The Northern Cape falls into the 1st quintile along with the Free State but the Free State has a percentage 3 times that of the Northern Cape. The province with the lowest percentage (2%) is Limpopo and it falls in the same quintile as the Western Cape (3rd quintile). All the players not born in South Africa were excluded in this table as well as those players who did not specify their place of birth in their profile.

Table 7. Distribution of Springbok rugby players per Province of Birth

Quintile	*n = 139*	*Percentage*	*Province of Birth*
3	40	29	Western Cape
4	25	18	Eastern Cape
1	21	15	Free State
5	21	15	Gauteng
4	11	8	KwaZulu-Natal
1	7	5	Northern Cape
2	5	4	Mpumalanga
2	6	4	North West
3	3	2	Limpopo

(Categories defined by population: 1= <2.8X10^6 people; 2= 2.8 X10^6-3.7 X10^6 people; 3= 3.7 X10^6-5.6 X10^6 people; 4= 5.6 X10^6-10.8 X10^6 people; 5= >10.8 X10^6 people)

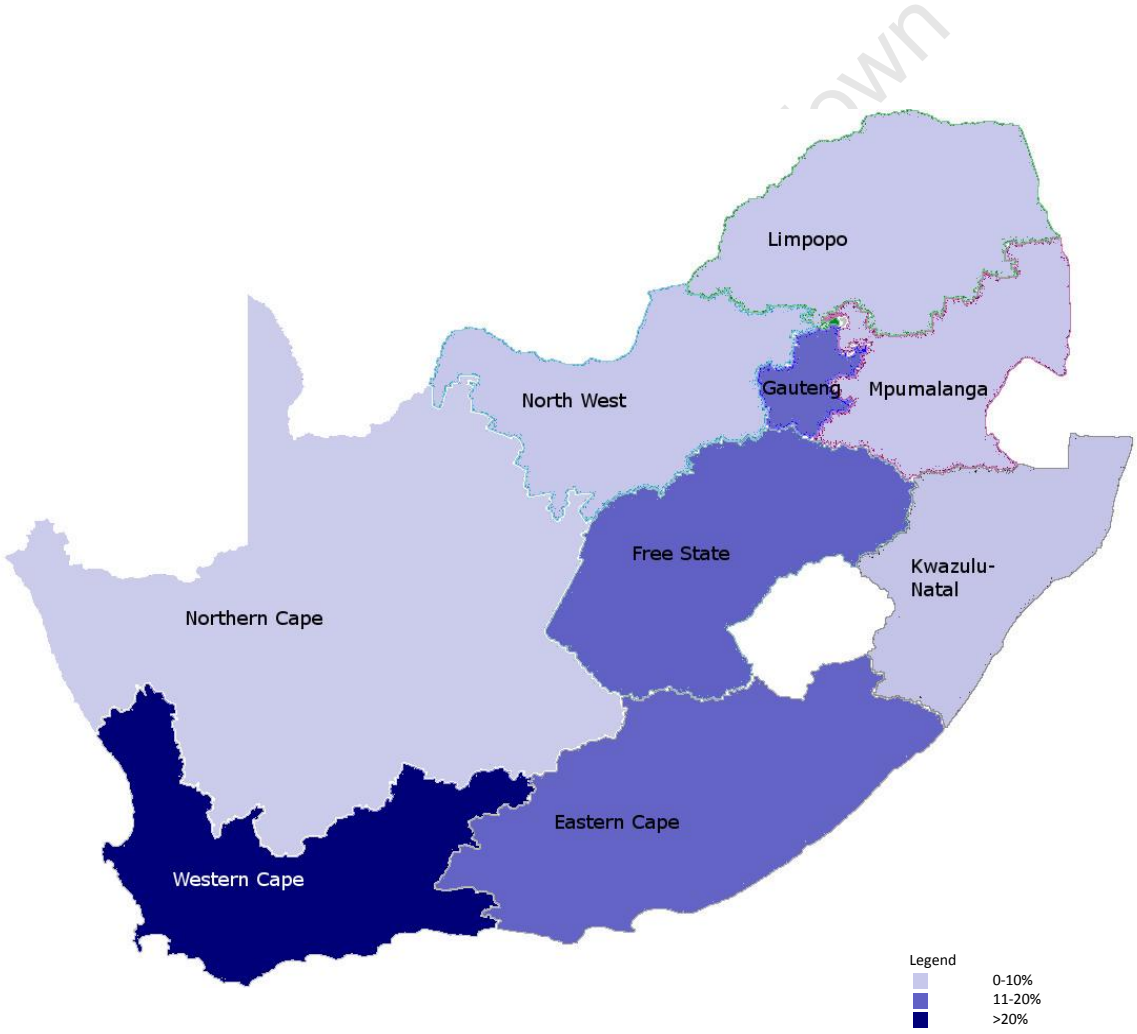

Figure 5. Birthplace of Springboks (2000-2010) represented as a percentage per province in South Africa

Discussion

The first finding of this study was that 68% of the players who became Springboks between 2000 and 2010, participated at the U18 Craven Week tournament between 1988 and 2008 (figure 2). At the culmination of each tournament, a SA Schools team is selected which consists of the best players at the tournament for that particular year. This study showed that 32% of the players who became Springboks between 2000 and 2010 were selected to the SA Schools team during their participation at U18 Craven Week (figure 2). These results suggest that participation at the U18 Craven Week is an important step in the pathway to achieving success in rugby union in South Africa. However, the relatively low number of players that progress from the SA Schools team into the national team suggests that being one of the best players at U18 level may have a limited role in predicting success at the highest level as an older player. Another explanation for this finding is that the best players are not selected in the SA Schools team due to quotas. The quota system or rather targets as it is known now, was introduced into South African Rugby Union after the apartheid era to increase the number of players of colour within the game.

In terms of talent identification, these findings suggest that U18 Craven Week is a good tournament for identifying talented players in South African rugby union. However, in terms of talent development, this stage may be too late in the maturation process to identify talented individuals with the aim of nurturing them. It is possible that before the players reach the under 18 level, the so-called late maturers may have stopped playing rugby to rather participate in sports in which there is less emphasis on size, e.g. cricket or football[6]. Research has shown that the maturity of adolescents differ according to their ethnicity[7]. This is relevant as South Africa has people of different ethnicities participating in rugby and may have an influence on selection and talent identification as one ethnic group may mature earlier than another. There are also big differences in terms of socioeconomic

status between South African adolescents[8]. This may result in those players from a specific ethnic group being excluded due to differences in their maturation or socioeconomic status.

The period between U18 rugby and senior rugby is the period in which South African rugby union has a high rate of players dropping out of the sport resulting in a smaller pool of talent from which to select[2]. By using U18 Craven Week as a platform from which to select talented individuals, rugby unions around South Africa may be contributing to this high dropout rate[2]. This approach excludes all the rugby players who do not participate at U18 Craven Week and could potentially result in these players being lost to the game of rugby. A strong club system would potentially cater for all those players that do not make it to the elite level in rugby. Unfortunately, club rugby in South Africa is not strong resulting in very few club players going on to reach the elite level after being excluded at a tournament like U18 Craven Week. Recently however, competitions such as the FNB Varsity Cup and the Club Championships have been established. These competitions are a platform for rugby players from various universities and clubs around the country to showcase their skills after leaving school. This could possibly cater for late maturers who have been excluded from U18 Craven Week or provincial teams.

The next finding of this study was that U18 Craven Week players who became Springboks were on average taller and heavier than the players who did not become Springboks. Nearly 70% of the Springboks with a previous playing history of U18 Craven Week were taller than the average non-Springbok player at the same U18 Craven week. This finding was similar for mass where 65% of the Springboks who had previously participated in U18 Craven Week were heavier than the average of their non-Springbok counterparts for that year. However, when interpreting these results it is important to keep in mind that position of the player was not controlled for. Had that been possible, the differences in stature and mass may have been greater. These findings imply that stature and mass at U18 level are associated to some extent with success at the highest level in South African rugby union. This is not surprising as stature and mass were associated with success at Rugby World Cups with the teams having the tallest backs and heaviest forwards performing the best[9]. These findings

have implications for talent identification and development since success at the highest level of rugby union is associated with higher stature and mass[9].

At U18 level, the maturation has occurred in the majority of the players thus allowing the late maturers to catch up to the early maturers especially in terms of stature and mass[10,11]. Therefore, selection of taller and heavier players during childhood and early adolescence may be detrimental to the development of those players that mature late[10]. The complexity of predicting adult stature and mass from a player during the early years of development further complicate the process of talent identification and development. Using the Beunen-Malina method, a standard error of estimate (SEE) has been calculated to 4.2 cm by Beunen et al while age-specific SEE ranges from 3.3 cm to 4.7 cm[12]. As mass can be influenced through various factors, especially that of conditioning[13], it may be beneficial to provide more players with an opportunity to develop mass (muscle) over time rather than attempting to identify individuals at an early stage of development. Therefore the future success of a player is dependent on being exposed to environments that promote player development such as good coaching and gym access. This will improve their chances of participating in tournaments such as Craven Week.

The Western Province Rugby Football Union is located in the Western Cape while Free State Rugby Union is located in the Free State. The Golden Lions Rugby Union and the Blue Bulls Rugby Union are in Gauteng. These unions are amongst the most successful unions in South African Rugby Union at both senior and junior levels which may explain the high percentage of Springboks born in these regions. In terms of schools, some of the most successful and prestigious rugby-playing schools are situated in these provinces and future research in this area may prove to be beneficial with regards to talent identification and development. This might explain why the birthplace of a player has a moderate affect on their success at a senior level. For example, 29% of players who became Springboks between 2000 and 2010 were born in the Western Cape while 15% were born in the Free State and Gauteng provinces (table 7). In total, more than half of the players that became Springboks in the defined period were born in 3 provinces with the remaining 6 provinces making up the balance. Cities with an estimated population of more than 65 340 people account for 55% of the players that

became Springboks between 2000 and 2010. Examples of cities of this size are Cape Town (Western Cape), Bloemfontein (Free State), Welkom (Free State), Johannesburg (Gauteng), Pretoria (Gauteng), and Boksburg (Gauteng). An explanation for this is that cities with a larger population may provide greater opportunities for player development[14]. It is no surprise that several of the country's top rugby schools are situated in the aforementioned cities. Schools such as Grey College (Bloemfontein), Paarl Gimansium (Paarl), and Afrikaans Boys High (Pretoria) are just some of the schools that have become well renowned for producing Springbok players (see Appendix A). Grey College (Bloemfontein) has produced 13 players (9%) of the Springboks between 2000 and 2010. The next school is Paarl Gimnasium with 7 players (5%). Only 2 schools have produced 4 Springboks while 6 schools have produced 3 Springboks during the aforementioned time period. These schools have a "rugby culture" and regularly compete against one another, providing a high level of competition. Moreover, the accessibility of facilities in these larger cities is also a lot better than the facilities in the smaller cities which would most likely play an integral role in the development of players. This finding is contrary to the findings of Côté et al in which they suggest that smaller cities provide greater opportunities for development[14]. It is important to note that the study by Côté et al was conducted in Canada and the United States of America and a small city was defined by a population of less than 50 000 people[14]. In comparison, a small city in South Africa is defined by a population of less than 7 360 people. In conclusion, the findings of this study suggest that participation at U18 Craven Week is an important factor for achieving success in South African Rugby Union. In contrast selection into the SA Schools team does not necessarily increase the chances for success at a senior level. While the U18 Craven Week is a good place to identify talent it may be too late in the maturation of a player for talent development. Certain provinces, rugby unions, and schools have been shown to be associated with a player achieving success at the elite level. Further research into the programmes and structures implemented in those regions may be beneficial in developing a comprehensive talent identification and development model in South Africa.

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CHAPTER 4:

Practical Applications and Recommendations

The findings of this study suggest that participation at U18 Craven Week is an important factor in achieving success in South African Rugby Union. In contrast, selection into the SA Schools team, which is determined based on the players' performance at Craven Week, does not necessarily increase the chances for success at a senior level. While the U18 Craven Week is a good place to identify talent it may be too late in the maturation of a player for talent development.

A schematic has been constructed showing the various levels of rugby from amateur age group levels, through to the various levels of professional rugby (figure 6). As can be seen in figure 1, there are several paths a player can follow to become a Springbok. There is no single pathway which guarantees success. Thus, all these paths (figure 6) need to be explored when identifying talented individuals. Certain provinces, rugby unions, and schools have been shown to be associated with a player achieving success at the elite level. Further research into the programmes and structures implemented in those regions may be beneficial in developing a comprehensive talent identification and development model in South Africa.

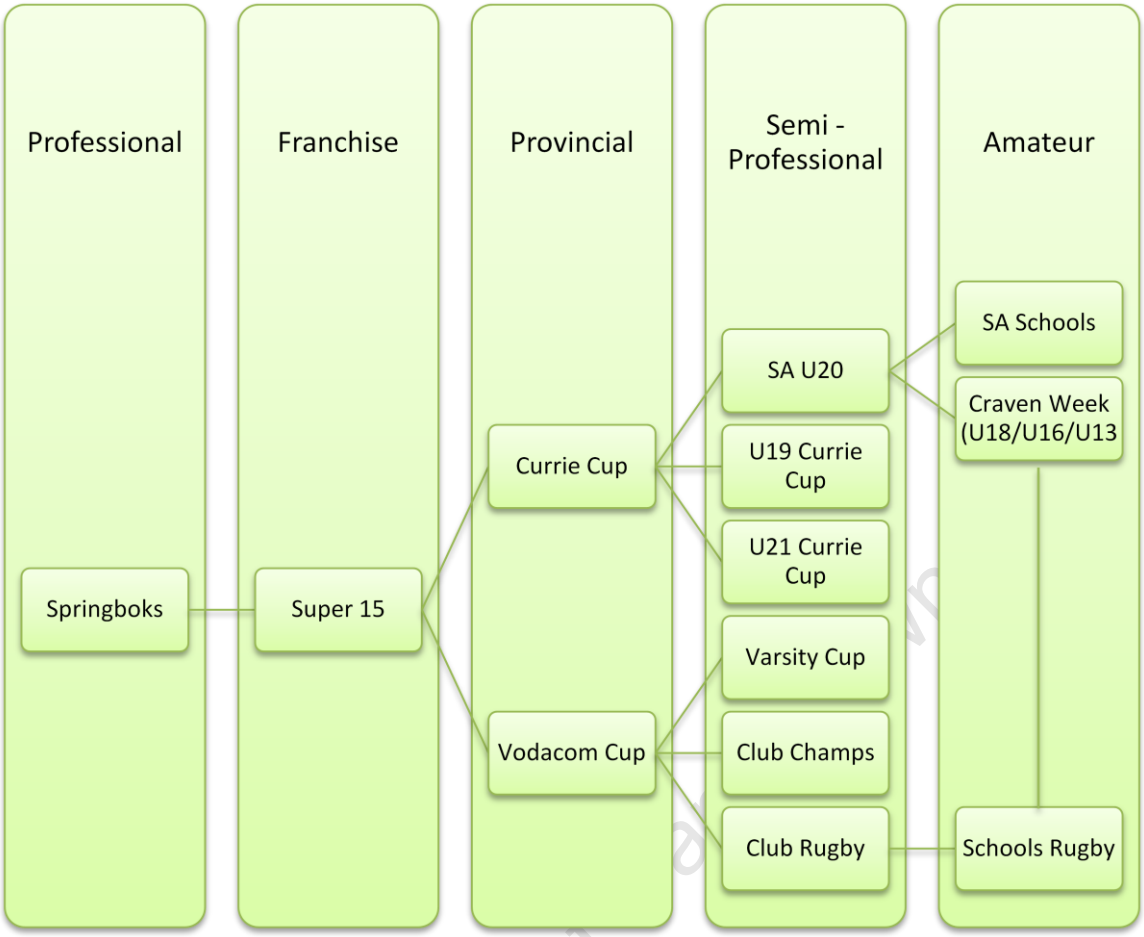

Figure 6. South African Rugby Union Pathway

Success in South African rugby union can be associated with, but not limited to, increased stature and mass of players at the U18 level. However, selection at any level based solely on stature and mass is extremely short-sighted due to the complex nature of performance in rugby union. Tournaments at younger age groups may be important for talent development rather than talent identification. These tournaments should be regional rather than national to promote more participation. It is important to consider the relative age effect when selecting age group teams especially during early adolescence (figure 7). The relative age effect decreases with increasing age (Chapter 2). An ideal scenario in a model designed to promote mass participation at a young age, the relative age effect should be measured to ensure that younger, less mature players are not being excluded. During the selection process it is imperative for the selectors not to mistake maturation and growth for ability.

The data show that Springboks attended different schools all around the country. Even though there are about 3 schools (Grey College, Paarl Gymnasium, and Afrikaans Boys High) that are renowned for producing Springboks, other lesser known schools have also nurtured players who became Springboks. This suggests that future talent identification and development programmes should target all schools that offer rugby as a sport rather than being restricted to the few top schools. Developing and nurturing talent across all schools rather than moving talented individuals to specific schools may allow for those players that mature later to be catered for instead of being excluded at an early age.

Figure 7 outlines all the competitions in South African Rugby Union in relation to maturation status. Before the adolescent growth spurt, a low to moderate training structure is recommended while the players engage in mini rugby and other similar formats. This would promote the development of all players prior to them reaching adolescence. During adolescence, individuals mature at different rates (early and late maturers). Also, during adolescence, the transition to the 15 man game is made. Early on in the adolescent period (age 11-13), individuals get their first exposure to a national tournament. However, when considering their maturation status, this tournament takes place prior to the growth spurt, which is advantageous to the early maturers. Therefore, in terms of talent identification the U13 Craven Week may not be the best indicator. U18 Craven Week coincides with a decline in the growth rate, which could explain why it is a good platform for talent identification.

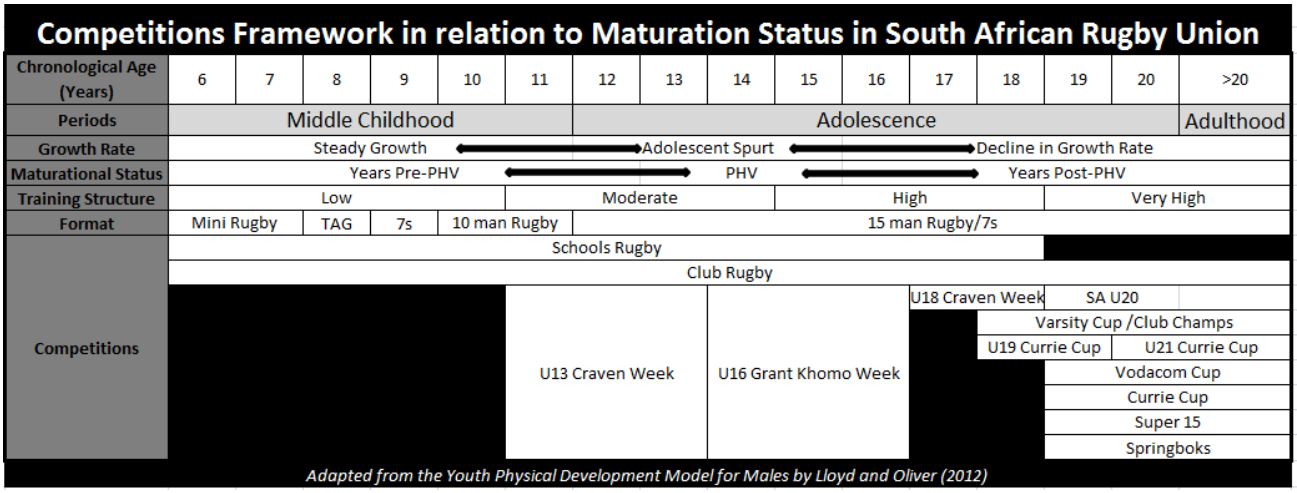

Figure 7. Competitions Framework in Relation to Maturation Status in South African Rugby Union

In conclusion, future talent identification and development models should account for the factors which are associated with success in rugby union. By accounting for both early and late maturers, dropout rates in young South Africa may be decreased in the future. As more than half of the Springboks that made their debut between 2000 and 2010 were born in 3 out of the 9 provinces in South Africa, the country as a whole could potentially benefit from the implementation of a talent identification and development model in all of the provinces with the aim of increasing the number of participants in rugby union around the country. Success at junior level does not necessarily translate into success at the senior level for both the players and stakeholders and therefore a model which promotes the development of all individuals (both early and late maturers) would be beneficial in increasing the talent pool available to the Springboks.

APPENDICES

Appendix A

The table below depicts all the schools that contributed the Springboks who made their debut between 2000 and 2010.

** if the player attended more than one school, the school the player indicated first was recorded.*

School	*n*	*%*	*Province*
Grey College	13	8.90	Free State
Paarl Gimnasium	7	4.79	Western Cape
Afrikaans Boys High	4	2.74	Gauteng
Monument	4	2.74	Gauteng
Boland Landbou	3	2.05	Western Cape
Dale College	3	2.05	Eastern Cape
Maritzburg College	3	2.05	KwaZulu Natal
Oakdale Agricultural	3	2.05	Western Cape
Paul Roos Gimnasium	3	2.05	Western Cape
Waterkloof High	3	2.05	Gauteng
Ermelo High	2	1.37	Mpumalanga
Hudson Park High School	2	1.37	Eastern Cape
Kathu High School	2	1.37	Northern Cape
Kearsney College	2	1.37	KwaZulu Natal
King Edward VII School	2	1.37	Gauteng
Kroonstad Afrikaanse Hoer Skool	2	1.37	Free State
Lichtenburg High School	2	1.37	North West Province
Peterhouse	2	1.37	Zimbabwe
Pretoria Boys High School	2	1.37	Gauteng
Rondebosch Boys High	2	1.37	Western Cape
Spine Road High	2	1.37	Western Cape
Alberton High School	1	0.68	Gauteng
Alexander Road High School	1	0.68	Eastern Cape
Bellville High School	1	0.68	Western Cape
Ben Viljoen High	1	0.68	Mpumalanga
Bishops	1	0.68	Western Cape
Bothaville High	1	0.68	Free State
Christian Brother's College	1	0.68	Gauteng
Daniel Pienaar HTS, Uitenhage	1	0.68	Eastern Cape
DF Malan	1	0.68	Western Cape
Dinamika High	1	0.68	Gauteng
Durban High School	1	0.68	KwaZulu Natal
Esselen Park High	1	0.68	Western Cape
Florida High School Roodepoort	1	0.68	Gauteng
Gelofte	1	0.68	KwaZulu Natal
General Hertzog High	1	0.68	Mpumalanga

George Secondary High School	1	0.68	Western Cape
Grey High School	1	0.68	Eastern Cape
Hangklip High School	1	0.68	Eastern Cape
Harrismith High	1	0.68	Free State
Hawston High School	1	0.68	Western Cape
Hentjie Cilliers (sports skool)	1	0.68	Free State
HTS Bloemfontein	1	0.68	Free State
HTS Vereeniging	1	0.68	Gauteng
Hugenote	1	0.68	Western Cape
JBM Hertzog High	1	0.68	Free State
Jeppe High School	1	0.68	Gauteng
John Vorster	1	0.68	Gauteng
Kalahari High	1	0.68	Northern Cape
Kasselsvlei	1	0.68	Western Cape
Klerksdorp High School	1	0.68	North West Province
Kloof High	1	0.68	KwaZulu Natal
Kokstad College	1	0.68	Eastern Cape
Kwamfumdo Secondary	1	0.68	Western Cape
Linden	1	0.68	Gauteng
Louis Botha	1	0.68	Free State
Loyiso High School	1	0.68	Eastern Cape
Marble Hall High School	1	0.68	Limpopo
Maria Louw	1	0.68	Eastern Cape
Michaelhouse	1	0.68	KwaZulu Natal
Middelburg High	1	0.68	Eastern Cape
Morester High	1	0.68	Western Cape
New Orleans High School	1	0.68	Western Cape
Nico Malan	1	0.68	Eastern Cape
Northwood Boys High	1	0.68	KwaZulu Natal
Outeniqua Hoerskool	1	0.68	Western Cape
Paarl Boys High	1	0.68	Western Cape
Pacaltsdorp Secondary	1	0.68	Western Cape
Pietersburg Hoerskool	1	0.68	Limpopo
Port Shepstone Secondary	1	0.68	KwaZulu Natal
Prieska Hoerskool	1	0.68	Northern Cape
Prince Edward	1	0.68	Zimbabwe
PW Botha College	1	0.68	Western Cape
Queens College	1	0.68	Eastern Cape
Rob Ferreira High	1	0.68	Mpumalanga
Robertson High School	1	0.68	Western Cape
Robinvale	1	0.68	Western Cape
Sand du Plessis, Bloemfontein	1	0.68	Free State
Sasolburg High School	1	0.68	Free State
Schweizer-Reneke High	1	0.68	North West Province
Scottsville Senior Secondary	1	0.68	Western Cape
Selbourne College	1	0.68	Eastern Cape

Settlers High School	1	0.68	Western Cape
Springs Boys High	1	0.68	Gauteng
Springs Technical	1	0.68	Gauteng
St Albans College	1	0.68	Gauteng
St Andrew's College Grahamstown	1	0.68	Eastern Cape
St Johns College JHB	1	0.68	Gauteng
St Thomas Secondary	1	0.68	Eastern Cape
Steenberg High	1	0.68	Western Cape
Stellenbosch High	1	0.68	Western Cape
Strand High School	1	0.68	Western Cape
Swartberg Secondary	1	0.68	Western Cape
Voortrekker High Bethlehem	1	0.68	Free State
Welkom Gimnasium	1	0.68	Free State
Weston Senior Secondary	1	0.68	Western Cape
Westville Boys High	1	0.68	KwaZulu Natal
Wilgerivier High	1	0.68	Free State
Zwartkop High School	1	0.68	Gauteng
Total	146		

Legend

School	High School attended*
n	Number of players
Province	Province that the school is situated in