The perceptions and practices of talent development for female cricketers: a skill acquisition perspective.

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Ph.D. Thesis

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Abstract

As the profile of women in sport continues to grow and the Australian Women's Cricket Team players become household names, the lack of representation by female athletes in research needed to be addressed. Through a detailed literature review from a holistic perspective, we have provided a foundation of knowledge for talent development in cricket using ecological dynamics as a contemporary approach to human movement and skill acquisition. The experiential knowledge of elite female cricketers and coaches was captured in two qualitative studies to ground the knowledge and theories of talent development with key stakeholder experiences. The initial investigation of perceptions and practices of talent development in cricket outlined an inherent reliance on talent identification, a linear pathway experience for players, a rise in professionalism, and misaligned coaching practices for skill development. To address these key issues, a grounded theory approach to professionalism was taken and the roles of athletes and organisations in promoting women's sport were explored. Two field-based experiments were then conducted centring on skill development approaches at the foundation level of the talent development pathway. Based on an informed framework of skill acquisition and representative task design, it appears that skill development at the amateur level could be improved to provide greater talent development opportunities for more female cricketers. A controlled trial intervention indicated that representative learning design is appropriate for skill development with amateur female cricketers, with improved skills in a majority of bowlers and batters. To support the ongoing growth of cricket for women, opportunities to compete and develop talent should occur beyond the talent development pathway in local cricketing communities by improving coaching practices and allowing players to develop at their unique rate. Key outputs from this thesis include a task design tool developed for coaches to support their approaches to skill and talent development, a grounded theory of professionalism for women in sport and a guide to creating holistic talent development programs.

FORM B
Certificate of Authorship of Thesis

Except where clearly acknowledged in footnotes, quotations, and the bibliography, I certify that I am the sole author of the thesis submitted today entitled –

The perception and practices of talent development for female cricketers: a skill acquisition perspective

I further certify that to the best of my knowledge the thesis contains no material previously published or written by another person except where due reference is made in the text of the thesis.

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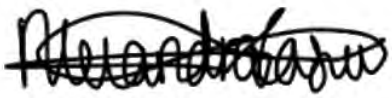

28/05/2021

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Lascu, A., Spratford, W., Pyne, D. & Etxebarria, N. (2020). Evaluating task design for skill development in an amateur female cricket team. *Physical Education and Sport Pedagogy*, 1-15. DOI:10.1080/17408989.2020.1752648.

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List of Conference Presentations

Lascu, A., Spratford, W., Pyne, D. & Etxebarria, N. (2019). *Talent development in women's cricket*. Presentation at the Australian Skill Acquisition Network, Sydney, AU.

Lascu, A., Spratford, W., Pyne, D. & Etxebarria, N. (2019). *Perceptions of talent development in women's cricke*t. Presentation at the World Conference of Sport Science and Coaching in Cricket, Loughborough, UK.

Lascu, A. (2019). *Using a games-based approach to skill development*. Presentation at ACHPER, Australian Institute of Sport, Canberra, AU.

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Lascu, A., Spratford, W., Pyne, D. & Etxebarria, N. (2021). *Representative learning design with amateur female cricketers.* Presentation at Cricket Australia SSSM, online.

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Chapter 1 Introduction

Talent in sport has featured prominently in sports science research for decades, from Olympic sports to community sporting teams. The need to identify, quantify and develop talent has evolved to a point where some U10's athletes are considered to be 'elite'. The insatiable search for talent in its earliest possible form to fill sporting teams with prospective athletes has overshadowed some important concepts of human development. Consequently, there is a growing presence of adverse psychological effects in youth athletes who are subjected to the rigorous and selective practices of talent programs (Brenner et al., 2019). Talent identification and development (TID) are often connected in research, and as such, our understanding of developing talent has been limited by the way it is quantified. The notion that talent is innate, or something an athlete is born with, stems from a reductionist understanding of human learning and development, which values an athlete's physical suitability to the technical movement demands of a sport above all else (Baker, Schorer, & Wattie, 2017). More contemporary and holistic approaches to both human and talent development instead highlight that an athlete utilises their surrounding environment to solve task-specific problems, valuing the abilities to adapt to challenging situations and make good decisions (Davids et al., 2013). The future of talent development thus lies in the ability to separate it from talent identification and create effective pathways, programs and practices that support the development of all athletes rather than relying on childhood physical characteristics to determine which athletes are worth investing in.

1.1 Significance of Research

Talent development research has predominantly centred on the experiences of male athletes with consistent underrepresentation of women and female athletes. There is little objective knowledge on talent development for female athletes despite increases in representation in other ways such as televised sports, contracted athletes and community participation numbers across a range of sports. Without this understanding, talent pathways and practices may emerge with abandon, relying on existing structures which have been based around the male athlete experience, and may differ greatly from how female athletes actually enter and experience sport. As more females gain access to sport for the first time, or gain recognition for their commitment to developing expertise, there is a need to develop a greater understanding of talent development from a female perspective. Improved opportunities for female athletes

should provide future generations with well-informed talent practices and programs that are effective, sustainable and supportive of their development.

1.2 Purpose and Research Questions

The aim of this thesis was to provide a foundation of knowledge in talent development for female athletes using contemporary approaches to understanding skill acquisition. In turn, the outcomes of this thesis are designed to provide sporting organisations with a review of current perceptions and practices in talent development for cricket, and an evidence-based approach to enhancing future programs and pathways for female athletes. Given the current lack of research on female cricketers, this thesis begins with the examination of experiential knowledge of athletes and coaches in talent development for female cricket. The initial themes uncovered by the first research question, professionalism in women's sport and skill development for amateur cricketers at the foundation level of the talent development pathway, are then explored using semi-structured interviews of leading cricketers, coaches and officials.

1.2.1 Research Question 1: What are the contemporary perceptions and practices for talent development in cricket for female athletes?

The growth and improvement of the next generation of female cricketers hinges on a detailed understanding of talent development. The current lack of knowledge on talent development in women's cricket reduces the ability to design impactful projects and provide safe, supportive learning environments for future players. To ensure the future of women's cricket, an understanding of contemporary perceptions and practices must be established. The landscape of cricket is shifting to promote greater participation among junior girls (Sport Australia, 2019), but it is unclear whether the current structure for talent development is suitable for this influx of developing cricketers. A qualitative approach harnessing experiential knowledge and grounded theory is needed to outline the elements of talent development in a holistic way. The key elements to consider are the contributions of talent development environments, sociodevelopmental factors (person) and training design (task) to talent development in women's cricket.

Women's cricket in Australia has experienced ongoing success on the international and domestic stages for the past decade and beyond. In this time, substantial changes have occurred in cricket competitions and contracting structures, resulting in the inclusion of national female cricketers in the revenue-sharing model that contributes to players' salaries. To achieve this outcome, a memorandum of understanding between the players and their national sporting organisation was renegotiated, potentially paving the way for other sports to follow. Other sports are also experiencing change, with growing criticism in football about the $37 million pay disparity between the men's and women's FIFA World Cup, and the emergence of women's rugby union competitions (Super W) in Australia on the back of the inaugural Rugby Sevens Olympic gold medal in 2016. It is unclear how these changes have affected the athletes within them in terms of performance expectations and liveability, but there is growing discussion that women's sport is entering a wave of "professionalism". With no existing definition for professionalism, it is difficult to discern if this is the case. This gap in knowledge and understanding is addressed by the second research question.

1.2.2 Research Question 2: What is professionalism and how has it influenced the development of female cricketers and women in sport?

The ongoing success of women's sport on the international stage has attracted more participants, media coverage, investment and opportunities to play in formalised competitions. The development of a women's Australian Football League (AFLW), a standalone competition for female cricketers in the Women's Big Bash League (WBBL), and equal prize money for tennis players at the Australian Open are evidence of this growth, but there is little documentation of how these sports developed these achievements. The increase in visibility and representation of female athletes on the international stage has also brought about scrutiny regarding their worth as "professionals", with little empirical evidence of what professionalism is. Earning money for performance and preparation in sport is believed to define athletes as professional, but professionalism has also been described as the "erosion of amateur attitudes, values and structures" (Kjær & Agergaard, 2013). This assertion suggests sports that may not be in a position to financially support their athletes may still achieve professionalism, or at least begin the process. To provide sports with a conceptual framework for professionalism, there is a need to establish its foundations and effects in women's cricket, with the potential to progress

all women's sport. A qualitative approach through grounded theory was devised to capture multiple perspectives from within cricket and other sporting organisations for understanding the evolution of professionalism and likely future effects on women's cricket and sport.

The advancements that professionalism has provided women's cricket is often limited to the elite and talent stages of the talent development pathway. These stages encompass players on state and national contracts, playing domestically and at the international level. As these players gain access to better support structures, staff, funding and professional contracts, they are expected to continue improving. Consequently, this investment may be causing a greater skill divide between amateur, state and national players. If an amateur cricketer has not entered the pathway before 18 years old, the only talent development environment they have access to is their local Premier Cricket competition. It is unclear whether current training practices are capable of promoting skill development to assist players in their pursuit of elite status or provide a competitive environment that encourages players to develop. An understanding of contemporary training practices at the amateur level is required to determine if effective talent development occurs beyond the pathway, providing all cricketers with the opportunity to develop. With rapid participation growth at the early stages of the pathway, this outcome may sustain the large influx of future cricketers to continue playing until they reach senior amateur level and beyond.

1.2.3 Research Question 3: How are amateur cricketers being trained and are they developing skill?

The linear approach to talent development pathways means early identification during adolescence is often a prerequisite for entering the talent stages and beyond. For those players who do not benefit from early identification, the amateur senior competition at their local cricket club is likely the only accessible talent development environment. This competition level is often run by community volunteers and entry-level coaches, with mixed levels of competencies when it comes to training design and the characteristics of expertise. To bridge the gap between amateur and state level cricket, a player must traverse the amateur sporting landscape to develop and outperform their peers with limited access to resources and minimal contact time. There has been little emphasis on amateur sport in previous research but the importance of the amateur training environment for talent development is evident for those

who did not benefit from early identification. A season-long observational study was conducted to establish current training practices and review them against empirical recommendations for representative task design and skill development. To synthesise the relevant research, a categorical assessment tool was devised with a 0-4 Likert-scale criteria for achieving representative task design.

Investigations into task design have highlighted that traditional approaches to practice in cricket may not be conducive of skill development (Low et al., 2013). The application of training practices to develop skill focuses on allowing functional behaviours to emerge, meaning these behaviours need not necessarily replicate a prescribed 'optimal' technique. These behaviours should be functional in the performance environment, requiring the training environment to make players think, feel and act as they would during the game. If players cannot search the environment for sources of information that they would normally have in the game (a live bowler approaching) or explore their task and adapt to challenges, the behaviours developed during training may not transfer into successful outcomes during the game. For example, batting in an enclosed environment (in a net) with a bowling machine has been shown to alter the movements of a batter in a less functional way (Pinder et al., 2011), creating a response that may reduce success in a game. By applying representative learning design (RLD) concepts to an intervention with amateur cricketers, amateur players would be exposed to these sources of information that are available in the game and learn to become attuned to them. Performing an intervention with amateur cricketers was necessary to understand how they interact with this learning process, and whether this approach to skill development could enhance the amateur training environment.

1.2.4 Research Question 4: How might representative learning design influence skill development for amateur cricketers?

Training task design at the amateur level of cricket is rarely reported in research, but the few existing studies highlight a disconnect between movement and sources of information (Pinder, Renshaw, & Davids, 2009). The amateur training venue is often dominated by enclosed spaces surrounded by netting, allowing batters to hit the ball without players needing to retrieve them. Bowling machines can also be used to place less pressure on live bowlers to train all night, but there are negative implications for skill development when training quantity is prioritised over

training quality (McCosker et al., in press). While increased exposure to task might be improved (i.e., facing more balls), this scenario trades off the quality of the skill being developed, and may reduce the likelihood of transferring from training to the game environment. Developing a skill without context, consequences for actions, an open space and/or opponents, may result in a dysfunctional game behaviour. Representative learning design aims to include the sources of information in the training environment evident during a game, allowing players to utilise them and become attuned to the information they provide. To determine whether amateur female cricketers benefit from training with representative learning design, an intervention study was created to provide a tailored skill development program.

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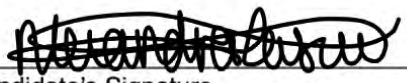
Declaration of Co-Authorship for Chapter 2

In the case of Chapter 2, the nature and extent of my contribution to the work was the following:

Nature of Contribution	Extent of Contributions (%)
Conception and design, acquisition and analysis of data, drafting and revising, final approval of version to be published, agreement to be accountable.	80%

The following co-authors contributed to the work:

Name	Nature of Contribution	Contributor is also a UC student (Yes/No)
Naroa Etxebarria	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
David Pyne	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
Wayne Spratford	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff



Candidate's Signature

Date 10/02/2021

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
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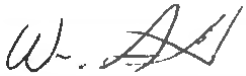	10/2/2021

Chapter 2 Literature Review

International Journal of Sports Science & Coaching

Review

Practical application of ecological dynamics for talent development in cricket

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Abstract

Talent development in sport is a comprehensive area of research with various conceptualisations of how the body moves and how skills are developed. The sports coaching environment is often criticised for a lack of evidence-based approaches to talent development, driven by limited access to appropriate sources of information. The current conceptualisation of motor learning, which harnesses dynamical systems theory and ecological psychology, is a complex and underdeveloped area in sport. Recommendations for talent development are often lost in complex pedagogies, so there is high demand for practical information on the translation of this knowledge. At its core, ecological dynamics views the body as a complex system which can reorganise to solve challenging problems in different ways, and emphasises that personal experiences, the task and the environment are all interacting. The specific elements of nonlinear development (person), representative learning design (task) and the talent development pathway (environment) are key elements for cricket coaching that are yet to be synthesised for the coaches who provide early learning experiences.

Keywords

Affordances, coaching, learning, sport, task design

Introduction

The sport of cricket is steeped in tradition with origins of international-level competition dating back to the mid-19th century with a women's team competing in Australia by 1890.[1] Since this time, there have been significant changes, not only in the way cricket is played but also how it is consumed by fans and spectators. These changes have challenged the progression of talent development in the sport as different formats of the game require specific skills that don't always transfer easily between shorter and longer and versions of the sport. Recently, commercialisation of the sport has created demand for a shorter, fast-paced version to attract a wider audience. Two versions have gained popularity in more recent years, featuring only 50-overs to score the highest total in one innings or 20-overs which challenges teams to score at the fastest run-rate. The game has also expanded to include thriving female competitions hosted around the world, competing predominantly in the shorter formats on the international stage.[2] Expert performance and skill development have also changed markedly as a result of these competitions, highlighting the demand for informed practice in the realm of a systematic evidence-based approach rather than an overreliance on tradition.[3,4] Despite a strong knowledge base for characterising expert performance in elite male cricketers, the understanding of how to develop these behaviours in female players is now beginning to emerge. There is also a demand for better knowledge translation to the coaches influencing skill development as practice recommendations are currently hidden in complex pedagogies.[5,6]

In sport and exercise science, the modelling of successful behaviours by other elite athletes was a commonly adopted approach for skill development.

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2.1 Introduction

The sport of cricket is steeped in tradition with origins of international-level competition dating back to the mid-19th century with a women's team competing in Australia by 1890 (International Cricket Council, 2019a). Since this time, there have been significant changes, not only in the way cricket is played but also how it is consumed by fans and spectators. These changes have challenged the progression of talent development in the sport as different formats of the game require specific skills that don't always transfer easily between shorter and longer and versions of the sport. Recently, commercialisation of the sport has created demand for a shorter, fast-paced version to attract a wider audience. Two versions have gained popularity in more recent years, featuring only 50-overs to score the highest total in one innings or 20-overs which challenges teams to score at the fastest run-rate. The game has also expanded to include thriving female competitions hosted around the world, competing predominantly in the shorter formats on the international stage (International Cricket Council, 2019b). Expert performance and skill development have also changed markedly as a result of these competitions, highlighting the demand for informed practice in the realm of a systematic evidence-based approach rather than an overreliance on tradition (Davids, Button, & Bennett, 2008; Penn & Spratford, 2012). Despite a strong knowledge base for characterising expert performance in elite male cricketers, the understanding of how to develop these behaviours in female players is now beginning to emerge. There is also a demand for better knowledge translation to the coaches influencing skill development as practice recommendations are currently hidden in complex pedagogies (Newcombe et al., 2019; Roberts, 2011).

In sport and exercise science, the modelling of successful behaviours by other elite athletes was a commonly adopted approach for skill development. An 'optimal' technique was believed to be the defining characteristic of expert performance, where elite athletes have superior ability to perform the same exact movement despite dynamic changes in the task or environment (Glazier & Davids, 2009; Seifert, Button, & Davids, 2013). This observation was based on the assumption that movement patterns are ingrained within the central nervous system (Ericsson, 2008) and then systematically developed through repetitive training of key components of the movement (Anderson, 1982). In this scheme, the absence of variability is deemed a defining characteristic of expert advantage. In contrast, an inquiry into the movements of elite athletes uncovered the opposite: for example, handball throws (Wagner et

al., 2012), long jump approaches (Scott, Li, & Davids, 1997), and expert fast bowling (Phillips et al., 2012) are characterised by the performer's ability to achieve a successful outcome by adapting their movements in relation to the changing task and environment. Traditional coaching in complex sports including cricket has often featured repetition of a single movement until it is mastered to develop an 'optimal' technique, despite motor control research encouraging practitioners to redefine how they view variability in performance (Sternad, 2018) and practice (Porter et al., 2019). Variability has historically been associated with error or lack of control in learning models (Fitts & Posner, 1967) but the current understanding of variability is that it can be functionally beneficial to performance. The search to control variability and to find unique, personalised solutions to game-related problems (e.g., scoring runs, taking wickets) should be prioritised over the 'optimal' technique approach to coaching.

Cricket features a complex contest between two teams on various levels: between the individual bowlers and the two batters; between the batters and the surrounding 10 players on the bowler's team (fielders); the environmental condition of the field and turf pitch, the weather, and the condition of the ball (Renshaw & Holder, 2010). This complexity has proved difficult to capture in skill acquisition, and key performance behaviours such as batting and bowling are often measured in controlled testing and training environments which might limit transferability to game conditions (Dicks, Button, & Davids, 2010). Under these controlled environments, there is little variability to test the players, omitting key sources of information including opposition fielders, bowlers (Phillips et al., 2012) or batters (Portus et al., 2010) that players rely on in the game (Orth et al., 2014). There are few characteristics which can be explicitly controlled within the cricket performance environment, so it is difficult to determine whether the behaviours rehearsed in training sufficiently represent those performed during the game. As contests between different people, the task and the environment typically occur simultaneously, this complexity needs to be captured in skill development practices to promote the transfer of skill between training and the game (Connor et al., 2016).

The theory that best captures multiple systems interacting in complex ways is the dynamical systems theory, where the human body is viewed as a multifaceted system. The human body's ability to reorganise joints and limbs to perform complex movement tasks is a key tenet of this theory (Bernstein, 1967), but it is evident in cricket (and other sports) that movement does not occur in isolation. There is an intricate connection between all elements of

cricket: the batter, the bowler, the fielders, and the overall game context (Araújo & Davids, 2011b). It is integral for coaches to understand that when a batter moves, the subsequent outcome (i.e., runs, wicket) comes as a result of the batter's ability to redirect the ball delivered by the bowler, the movements of the fielders, and the context of the game (i.e., batting first or chasing, balls remaining, required run rate, competition level, etc.). This connection should also be maintained during skill development to ensure that the learned behaviours also emerge in the performance environment (Pinder et al., 2011b; Woods et al., 2019).

Cricket is dominated by a large array of visual information which is available for the performer to utilise and inform their next movement (Farrow & Abernethy, 2015). Our understanding of the way this information is harnessed no longer features the need to cognitively process visual and spatial information because in some cases, there isn't enough time between the bowler letting go of the ball and the ball arriving at the batter (Müller & Abernethy, 2012). Instead, visual information of all kinds flows in a landscape that surrounds the person, available for use without the need to process it (Gibson, 1979a). This information could contain broad knowledge like the fielder's positions in relation to the batter, or acute details such as behavioural cues of the hand, wrist, arm, or torso as the bowler approaches the crease. This information helps to inform the next action, and that action can also provide the player with different or new information. The coupling of what we see and how we move is referred to as perception-action coupling (Araújo & Davids, 2011b). For example, moving forward to intercept the incoming ball as a batter may provide a new perspective of the field and fielding at certain angles from the bat influences when and how the ball might come to you. Becoming attuned to these sources of visual information is part of the learning process; just because a visual source is available does not mean necessarily that a performer knows how to utilise it (Davids et al., 2008; Jacobs & Michaels, 2007). To become attuned, those same sources of information need to be present in the learning environment (Partington & Cushion, 2013). As learners become attuned to the information that surrounds them in the task and environment, the skills and behaviours they have developed become opportunities to act, otherwise known as affordances (Gibson, 1979a). When the affordances found in the game environment are available at training, learners can explore the surrounding sources of environment to promote the transfer of skill.

For example, a batter is likely to achieve a successful outcome (scoring runs) if they perceive there is a gap in the field, and they possess the necessary skill to redirect the ball there. This process is also dependent on whether the ball delivered by the bowler can be redirected to the desired location. Affordances are not only context-dependent but also highly individualised (Davids et al., 2013). The skills or capabilities that one player possesses may not result in the same movement that another player uses to achieve a similarly successful outcome, highlighting the need to move away from an 'optimal' technique approach to provide individualised coaching (Glazier et al., 2005). As both skills of batting and bowling are governed by the laws of physics (collision of bat and ball, angles, summation of forces, levers, transfer of momentum), coaches should be aware that differences in physical and mental attributes afford unique movement solutions (Connor, Farrow, & Renshaw, 2018). As the learning process becomes individualised, the role of the coach becomes facilitative rather than instructional, with an emphasis on creating the optimal learning environment (Martindale et al., 2007).

The theoretical approach which best captures the complexity of athletes and sporting teams as an adaptive system, and how they interact with available information, is ecological dynamics, has been used as the basis of this review. The two underlying tenets for coaches to understand feature: the constant interaction between a person, their task and the environment and that perception (what a player sees) and action (how they move) are coupled, continually informing each other. As earlier attempts to apply similar learning approaches to cricket have proven difficult for cricket coaches (Roberts, 2011), and few attempts have been made to bridge the game between research and practice (Woods et al., 2019; Côté, 1999), we examine the three domains of ecological dynamics in the context of cricket: nonlinear development (person), representative learning design (task) and the talent development pathway (learning environment).

2.2 Person – Nonlinear Development

The personal factors that influence talent development extend beyond the physical characteristics and traits of an individual. The early developmental experiences of young athletes shape their behaviours through interactions with other siblings, their birth order within the family, and relative age when selected within a cohort among other athletes (Côté, 1999; Pankhurst & Collins, 2013). The motor learning that occurs at this young age is facilitated by

interactions with siblings in a home environment (e.g., backyard) and experiencing a variety of sports, providing a strong foundation for learning based on curiosity and problem solving (Cannane, 2009; Memmert, Baker, & Bertsch, 2010). While some elements of nonlinear development cannot be controlled, early unstructured play and sampling sports can be encouraged to build a stronger base for skill development.

2.2.1 Sibling, relative age and maturation effects

The socio-developmental environment that young learners are exposed to is recognised as a key component of developing expert athletes. Backyards and playgrounds are initial locations for skill development, where informal play allows learners to explore different movement patterns, creative problem solving and feed the learner's curiosity. This play behaviour is often facilitated by the presence of others, where the role modelling and social interactions between siblings and their subsequent success for their chosen sports is important. Studies have predominantly focused on male athletes, so the interactions between female cricketers and their family or friends is yet to be formally explored. While the presence of a sibling can positively influence skill and social development by providing a partner for unstructured play, they also form a source of emotional and instructional support, or a role model to younger siblings (Davis & Meyer, 2008). For those learners lacking this interaction, the social learning occurs at grassroots programs with peers and coaches, modelling behaviours and searching for emotional and instructional support in the community. Younger siblings often show a greater level of commitment and experience early success (Hopwood et al., 2015), so the development of older siblings becomes largely based on a supportive peer base and welcoming learning environment which community coaches should aim to provide.

Skill development occurs as a function of biological age, with each individual maturing at different rates (Renshaw et al., 2009). More specifically, the sources of information that can be understood and perceived change with age as physical and mental development continue to progress (Weiss, 2008). In combination with the physical capabilities developed from exploring the environment, young learners also usually develop several mental skills with advancing age, including courage and the ability to handle pressure (Abbott et al., 2005). As age-based competitions are the foundation of entry-level sport, it becomes difficult to distinguish the difference between advanced skill development and early physical maturation (Musch & Grondin, 2001; Pankhurst & Collins, 2013), especially between children born at the

start or end of the year (Wattie, Schorer, & Baker, 2015). The effects of relative age, which is the specific age at a certain cut off point in the competition year (Barnsley, Thompson, & Barnsleym, 1985), have been explored in a variety of team sports including rugby league (Till et al., 2014) and basketball (Delorne, Chalabev, & Raspaud, 2011). A recent investigation into Australian Football (Tribolet et al., 2019) provides insight into the relative age effects, identifying that the confusion between early maturation and advanced skill development extends to perceptions of performance through nominations for awards and draft selection. In highly physical cricket skills such as batting and bowling, similar misconceptions may be made at an early age, potentially limiting access to the talent development pathway based on early selection (Wattie et al., 2015).

In junior representative teams, these players are often successful as a result of their early maturation and therefore dominate selections. If talent development environments are to prioritise development over early success, players that may lack early strength but display tactical knowledge or understanding of the game should also be rewarded with selection for representative teams or academies. If this approach is applied, the other physical and mental aspects of talent development in sport can also be used to evaluate player development. Each person experiences the unique physical effects of puberty at different rates, causing movement patterns to become unstable as the body recalibrates to new limb lengths, growth spurts and other changes affecting body composition (Renshaw et al., 2009). This variable pattern of development is linked to temporary decreases in player performances around puberty (Pankhurst & Collins, 2013), with the added pressure of balancing social implications of skill proficiency and self-efficacy when trying to keep up with peers. It may not be socially acceptable to compete with younger athletes but not all early learning experiences are positive or develop the foundational cricket skill to continue through higher levels of competition. To address this shortcoming in the junior cricket pathway, two separate competitions with revised playing formats are now available for those with the skill proficiency to compete and others who simply enjoy participating (Cricket Australia, 2019). The revisions featured scaled equipment, reducing the length of the pitch and side of the field to make batting and bowling easier to achieve and also promoting learning through the game (Buszard et al., 2014). This approach can improve skill proficiency early in the learning process and allow players to overcome the effects of early maturation in junior competition (Martindale et al., 2007).

As young athletes become exposed to the talent development pathway, it is crucial to ensure that learning experiences at the community level are robust enough to accommodate for individual rates of development. The emphasis on selection and early success over long term development can confuse early maturation with advanced skill development increasing the social consequences of missing out of selections (Pankhurst & Collins, 2013). Allowing young players to explore and compete in a supportive environment can improve skill development to overcome an absence of early learning and the effects of early maturation. This works best when coaches individualise learning tasks and environments to suit the mental and physical skills of the learner.

2.2.2 Early unstructured play and sampling sports

Cricket benefits enormously from large-scale participation and unstructured play that takes place in households as one of the most popular games for children in selected countries (Sport Australia, 2019). This element of creative play builds social, emotional and physical skills as young learners explore fundamental movement skills (running, jumping, catching), how to compete with others, constructing play rules ("six and out"), bouncing back from failure (resilience) and problem solving. These skills often transcend the specific game-based rules of sport, where sampling a variety of skills between the ages of 5 and 12 years is believed to be beneficial for developing athletes (Côté, Baker, & Abernethy, 2007). Informal play such as backyard cricket is highlighted as a key early learning environment for expert cricketers in the past, with family and friends shaping behaviour and promoting creative problem solving to avoid windows, orange trees or hitting against sloped driveways (Cannane, 2009; Weissensteiner, Abernethy, & Farrow, 2009). In contrast, physical environments of suburbia including smaller backyards (Hall, 2010) and generational shifts in play behaviour (e.g., screen time, social media, indoor activities) (Yu & Baxter, 2015) have increased the demand for these skills to be developed in a more formal environment.

Developmental programs are now addressing this lack of foundational skill by designing games-based programs specifically for early skill development. The sport of cricket depends on the interaction between a batter and a bowler, which requires a large degree of skill execution. If a young bowler cannot provide the batter with a ball to hit, or the batter cannot interact with a moving ball, time on task and enjoyment are markedly limited. Grassroots programs are expected to develop cricket-specific skills for early learners while maintaining

enjoyment, which are currently being addressed through small-sided games (Cricket Australia, 2020c) which also feature in other participation sports such as soccer, basketball and Australian Football (Pill, 2012). While the presence of defenders, or fielders, can be overwhelming to begin with, the interaction between them and the player is integral to the game (Orth et al., 2014). Therefore, the game can be scaled down or adapted to allow for the emergence of key behaviours with a shorter pitch, smaller boundaries or less fielders (Buszard et al., 2014). This adaptive approach also creates an opportunity for more time on task for fielders, with more chances of receiving the ball and more competitive games to maximise learning. Batting in pairs for 24 balls (or four overs) without consequences provides a holistic game experience but entering formal junior competition may still be a difficult transition (Cricket Australia, 2020d). Diverse experiences in other sports could possibly aid in the development of patience, resilience and problem solving while also protecting against stress and burnout in young athletes (Pankhurst & Collins, 2013). By allowing young athletes to access games-based learning programs from an early age, skill development can still be facilitated in an unstructured way despite decreases in informal play across generations (Active Healthy Kids Australia, 2018).

Participating in multiple sports allows young athletes (up to 12 years of age) to experience a variety of skills and is a key socio-developmental element of elite athletes (Côté et al., 2007). A substantial time commitment is expected from each individual sport, making it difficult for young learners to maintain diverse activities and a healthy mental status (Brenner, et al., 2019). Consequently, over-commitment to one single sport has been linked to an increased likelihood of dropping out and burning out, so sampling a variety of sports is a protective factor against future physical and mental development (Cairney et al., 2018). The effects of sampling sports and entrance into talent promotion programs have been explored in Olympic athletes to characterise differences between world-class and national-levels competitors (Vaeyens et al., 2009). World-class athletes entered the international space at a later stage, invested more time in training for other sports, and transferred sports at the latest stage of the junior pathway. While this counteracts the focus on early success in junior sporting teams, club coaches still maintain a heightened expectation of their athletes to specialise in one sport (DiSanti et al., 2019). Similar outcomes were reported in 1,558 athletes from diverse sporting backgrounds where sport-specific training loads and success during adolescence were poor predictors of success at the top level of their chosen sport (Güllich & Emrich, 2006).

While cricket is not an Olympic sport and may provide different pathways to success, research indicates that world-class expertise is facilitated through investing in diverse movements and delayed engagement in talent pathways. The current demand for deliberate practice in one sport through the pathway at a young age is counterintuitive, and community coaches are encouraged to recognise the value of sampling sports for skill development in young athletes by allowing them time to commit.

2.2.3 Practical Considerations

There are multiple factors that influence a young athlete and their development in sport. While the majority of these factors occur out of the control of the coach, awareness of the various early learning experiences, and how they shape each individual can assist those working at the grassroots level. It is important that young learners are encouraged to engage in unstructured play, which can occur within or outside traditional training settings. This element of game-specific learning is best complemented with experience in a variety of sports and games, so training for other sports should be considered a strong asset as 5-12 year old learners navigate the sampling years (Côté et al., 2007). Awareness of early maturation and nonlinear development also allows coaches to combat the traditional bias towards early maturation over skill development by providing personalised positive learning experiences. Early skill development should focus on exploring new movement patterns and creative problem solving to encourage ongoing learning and curiosity.

2.3 Task – Representative Learning Design

Historically, motor learning research has featured the human brain as a computer-like hard drive that simply inputs information and outputs movement (Atkinson & Shriffin, 1968). Learning has traditionally been conceptualised as a predominantly linear process, where learners progress through stages depending on how much they think about the task and error rates (Fitts & Posner, 1967). Repetitive, deliberate practice for 10,000 hours (Gladwell, 2008) was deemed necessary to achieve expertise, but this notion fails to consider that each individual is unique. The nonlinear nature of physical and mental development extends to the development of expertise as well, where unique approaches to movement and problem solving should be accounted for in training practices. The current understanding of motor learning features a brain that is receptive of the surrounding visual information without needing to

process it, allowing learners to use the information and knowledge of their own skills to shape their movements (Davids et al., 2015; Gibson, 1979).

2.3.1 Skill acquisition and perception-action coupling

There are a number of models detailing how learners acquire skills and how experts differentiate from novices. Early conceptualisations of these models featured deconstructed concepts of computing, comparing the human brain to the simplicity of a hard drive. A classical model used in education curricula featured three stages, where graduating from one to the other was easily observable through reduced error rates, fluid movements and cognitive or attentional focus (Fitts & Posner, 1967). The underlying assumption of this classical model was that learning occurs in a linear way, and progressing through the stages requires repetitive, deliberate practice (Coughlan et al., 2014; Ford et al., 2015). Contrarily, it is now commonly believed that skill development is largely nonlinear because expecting each individual to progress through the same predetermined stages is unrealistic (Chow, 2013). Teaching practices have also changed to reflect this notion, where skill development practices in the classroom and the local sporting clubs are beginning to align by employing nonlinear pedagogy (Chow et al., 2016). Instead of operating as a hard drive, the human brain is likely to be more receptive to the information that we see around us. The way a player moves in a complex sport like cricket derives from their perception of the available information sources and the actions they can perform (skills) (Gibson, 1979; Le Runigo, Benguigui, & Bardy, 2005). The coupling of perception and action is therefore an integral part of the learning process so that movements emerge based on the same information that is present in the game environment.

The presence of these sources of information in a training environment are what make it representative of the performance environment, increasing the likelihood that a skill may transfer from one to the other (Pinder et al., 2011a). Representative design was initially detailed by Brunswik (1955b) in the context of experimental design in psychology as "representative sampling of situations". In this section of the manuscript, Brunswik likens the sampling of a situation similarly to the sampling of a population by including the components that contribute to 'functional achievement'. In this context, the experimenter acts as a supervisor to control the adequacy of the sampling, similar to the control that a coach has in designing a training environment. Pinder and colleagues (2011a) later adapted this concept into the sporting context, translating the concept of representative design into representative learning design,

which refers to how well the training environment represents the behavioural demands of the performance environment (Yiannaki, Carling & Collins, 2018). It is important to consider the origin of these sources of information as training does not need to perfectly replicate a game but should sample the information that players use to inform their actions (Pinder et al., 2011a). In cricket, expert batters utilise visual anticipation by identifying cues in a bowler's approach, arm position, ball seam and previous situational experiences to prepare their movement response (Regan, 1997; Sarpeshkar & Mann, 2011). Bowlers can utilise similar sources of information in the batter's feet, bat and skill execution and their own skill execution to inform the next ball they bowl (Phillips et al., 2012). The relationship between the batter and the bowler, which extends to the fielders surrounding the bat, needs to be present when training those skills. To observe what happens when key sources of information are not present, Pinder and colleagues (Pinder, Renshaw, & Davids, 2009) examined differences in batting movements when facing a bowling machine compared to a real bowler, capturing the way information and movement were coupled in this skill. While a bowling machine (initial ball flight) preserves some important characteristics of the game, the batter's front foot movements and initiation of backswing - two crucial components of an attacking bat swing - were delayed. The reduced within-task variability and lack of advanced cues from a bowling machine compared to a real bowler encouraged maladaptive batting behaviours in the experts, while developing batters displayed no difference between the two conditions. These observations highlight the importance of coaches providing learners and experts with a training environment which features the key sources of information they would use in a game.

The learning process also includes becoming attuned to these sources of information, as their presence alone is not enough to help inform actions (Jacobs & Michaels, 2007). It is worth considering that the utilisation of information occurs in a unique way, as each individual may have their own movement solution to solve the same game-based problem that all cricketers are faced with (scoring runs, taking wickets) (Glazier et al., 2005). There is a growing empirical understanding of training practices within cricket, with the rise of games-based approaches evident in other sports as well including Australian football, tennis, soccer and rugby. Low and colleagues (2013) detailed training practice microstructures by capturing the percentage of session duration spent on training form (no decision making, technical practice) or playing form (small sided games, open practice) with comparisons to previous attempts in other sports. While recreational athletes spent half their time in the field, the high amounts of

training form in nets for elite and adolescent athletes comes in contradiction with current research. The lack of progression to more open, games-based play to promote decision making and adaptability is believed to limit transfer to the game environment, with sports like tennis integrating the manipulation of court size into their coaching manuals to promote match-play form (Pill & Hewitt, 2017).

The application of small-sided games has been shown to develop physical, tactical and strategic thinking skills simultaneously (Oppici et al., 2017; Pill, 2012). In football (soccer) training for example, passing channels are best sampled using live defenders, which simulates the pressure of a game context and encourages learners to explore their options in an environment where failure is supported (Uehara et al., 2018). The passing channels appear organically, just as they do in a game, and by providing a task constraint such as a number of passes in a row, players begin to explore their environment and unconsciously catalogue successful and unsuccessful attempts. In cricket, these channels between players appear as gaps in the field for a batter, or bowling line for the bowler, but just as the performance environment features substantial variability and a live contest, the training environment should also feature these elements where possible. The variability of having realistic opponents helps simulate the performance environment (Gorman & Maloney, 2016), so practicing batting skills with the inclusion of fielders in an open field environment during cricket training may allow the skill to transfer from training to a game situation (Orth et al., 2014; Pinder et al., 2011b). Further investigations must be made before the contributing components to skill transfer, including open fields, can be fully understood. While this scenario can be difficult to recreate in an enclosed net environment, sampling information such as the relative location of such fielders by placing markers on the ground, or pegs on the net, can help inform decision making for runs-scoring while batting.

The application of representative learning design does not need to perfectly recreate the performance environment (Panchuk, Farrow, & Meyer, 2014), but training cricket skills using this framework can promote skill development for improved game performance (Pinder et al., 2011b). The application of modified games is present in many junior development programs, but this practice is rarely harnessed at the later stages of development when learners have developed the ability to critically analyse and make informed decisions. A lack of access to an open field environment can be overcome by using other contextual factors, such as

observationally based runs-scoring using bat-ball contact and a simulated field to determine success in a closed environment. The presence of goal setting or game scenarios can also be used to sample the mental demands of the game, providing an environment for holistic skill development.

2.3.2 Practical Considerations

The underlying tenet of representative learning design is ensuring the training environment provides the same sources of information that athletes use within the performance environment. As the contest between bat and ball is the main feature of cricket, this relationship should be maintained for information and movement (perception and action) coupling to occur in a functional way. The application of modified games is a recommended method of training to improve representativeness and promote holistic skill development. However, there may be limited access to resources at the grassroots and club levels of the sport. This limitation can be overcome with session planning to include contextual information (observational runs, game scenarios) to encourage the simultaneous development of physical and mental skills. The effective application of representative learning design allows players to develop functional movements that are more likely to transfer to the game because they have become attuned to the key sources of information, and how they can best utilise them to achieve a successful outcome.

2.4 Environment – The Talent Development Pathway

Research into talent has been dominated by its desire to pinpoint expertise as early as possible. This notion has encouraged the formation of elite junior academies and focusing on one sport early, contradicting recommendations for early unstructured play and sampling sports despite their known contributions to elite performance in adulthood. As current physical performance and future potential are poor predictors of future success (Koz, Fraser-Thomas, & Baker, 2012), it is integral to support development throughout the pathway to success. While a robust pathway system already exists within major participation sports like cricket (Gulbin et al., 2013), the environments these pathway systems provide learners with can be improved by focusing on long-term, holistic development. The environment that learners are exposed to extends beyond the physical elements of a backyard or locality. The cultural learning environment that the talent development pathway provides, with access to quality coaching and

opportunities to learn, is also a key environmental domain (Renshaw & Holder, 2010). Recent evidence-based recommendations have encouraged sports to provide opportunities for development and access to coaching beyond the talent development pathway (Pankhurst & Collins, 2013).

2.4.1 Selections and the pathway

Talent identification has featured heavily in many sporting organisations in the search for the earliest performance indicators of a young athlete being successful long-term (Martindale, Collins, & Daubney, 2005). Football programs are notorious for scouting players before the age of ten years old and placing them in elite academies (Kirkland & O'Sullivan, 2018). However, there are socio-developmental consequences of focusing on 'giftedness' rather than work ethic and deselection from a representative team or program (Abbott et al., 2005; Güllich, 2014). There is little evidence to suggest that early entrance into specialised talent programs is integral for adult success but engagement in organised sport can promote free active play in children, a crucial early learning experience (Cairney et al., 2018). While sport-specific academies may present young and developing athletes with access to resources, the use of talent identification based on current physical performance and potential has been criticised for being poor predictive factors of future talent and adult success (Koz et al., 2012; Vaeyens et al., 2009). A focus on development is now being emphasised to allow for an extended learning experience and later selection, which is ultimately more effective than early identification (Güllich, 2014).

Talent development pathways in the past have featured stages or steps which illustrate the potential progression from participation to elite performance, but they were often constrained by age and featured little information on how learning progresses deep into adulthood. A widely used model that informs Olympic sports has been adapted to inform the Australian talent development pathway for cricket, featuring four stages (Figure 1): a Foundation stage which captures free play; a Talent stage where junior regional and state/county selections begin to occur; an Elite stage which encompasses the adult state and national level athletes; and a Mastery stage where success at a national or international level is sustained (FTEM) (Gulbin et al., 2014). The female talent pathway does not currently feature a second-tier national competition, creating a gap between the end of the junior talent stages and the elite senior stages of the pathway (Cricket Australia, 2020a). The later rise of

professionalism in women's cricket also means that the pathway was shaped entirely on the existing men's programs with little understanding of the differences in upbringing, development, exposure and opportunities to engage with the pathway for current or recent elite female athletes. While the absence of specific age levels is considered a benefit in this model, the lack of information beyond the competition structures highlighted in the model's adaptation to cricket can be limiting.

Figure 1. Cricket Australia's (2015) Talent Development Pathway adapted from the FTEM model by Gulbin and colleagues (2013a).

In such a complex sport like cricket, it is difficult to set specific skill-based benchmarks or achievement expectations while maintaining the importance of nonlinear development. To highlight how nonlinear and unique the road to elite status can be, Gulbin and colleagues (2013) studied the paths to success for 256 elite athletes across 27 sports. Not all athletes entered their sport of specialisation at a recreational level and only 16% of patterns to the elite level of their sport were entirely linear by graduating through each stage of the pathway. Instead, zigzagging patterns were experienced by the majority of athletes, characterised by fluctuations between

the stages and sides of the pathway, which can include congruent participation in adult competition and junior academies in cricket. Most importantly, senior success was rarely achieved through only the junior or senior pathway (7%), again highlighting the importance of developmental experiences from coaches and programs outside of the pathway and the prevalence of nonlinear development in the pathway. As presented, the FTEM model and its adaptation to cricket presents a linear approach to talent development with little opportunity or understanding of how to move between the various stages, especially if early entrance is not achieved.

2.4.2 Talent development environments

The talent development pathway has evolved via research and empirical evidence but the practices that occur within each stage are yet to be fully characterised. A talent development environment is defined as "*that which adds to the development of those identified as talented*" (Martindale et al., 2007), which highlights the fixation with talent identification that has dominated sport. Challenging this notion, research within the UK elite sporting system evaluated the congruence between research concepts and practice for talent development in a sample of coaches from 13 different sports. In this study, the majority of coaches supported the notion that long-term aims and methods (83%), development over 'early success' (87%) and coherent messages for holistic development (93%), were all integral aspects of talent development. To accommodate for the nonlinear nature of development, the opportunity to access talent development should not be restricted to those who benefit from talent identification and early success. Ongoing, holistic development experiences outside of the pathway alongside fluid transition into and out of the pathway should feature in cricket to achieve long term aims and make it "*a pathway for all*" (Cricket Australia, 2015). Extending the reach of talent development may allow amateurs to continue along the pathway despite their lack of early entrance or late maturation with a diverse set of skills, as found when Olympic athletes delayed their entrance to pathway programs (Pankhurst & Collins, 2013; Vaeyens et al., 2009). This in turn may improve the standard of the senior amateur competition (Premier 1sts) stage which is the only talent development environment for those who have surpassed the junior talent stages and are yet to break into the senior stages. By putting the focus back on club coaches and state/county associations to provide these ongoing opportunities, local cricket clubs become the foundation of talent development for all athletes,

especially when training sessions foster expertise by allowing adaptable and decisive players to emerge (Cricket Australia, 2020b; Partington & Cushion, 2013).

2.4.3 Practical Considerations

While a shift in sports science has emphasised the value of ongoing development over early identification, it is difficult to see how this development is presented within the current pathway structure. The gap between entering the high-performance system beyond a linear trajectory from the junior stages of the pathway is growing with the rise of female professionalism, with the need for talent development opportunities beyond the pathway. Given the elite stage is reliant upon amateur senior competitions, talent development environments now reside with local clubs and state/county organisations, allowing more cricketers to access ongoing development if training practices are well-informed. The benefits of this growing catchment for development may only be seen when the transition into and out of the pathway occurs more fluidly, allowing those who mature late or diversely skilled amateurs to continue along their talent development journey. This requires ongoing support and a commitment to the long term aims from the local cricket clubs to the high-performance programs.

2.5 Summary

Cricket is a complex sport best viewed through the lens of ecological dynamics, allowing coaches and practitioners to take a holistic approach to talent development. By maintaining the connection between person, task and environment, the pathway becomes a more supportive, consistent approach to talent development (rather than identification) by reducing the emphasis on early indicators of success in children. The importance of positive early learning experiences in communities and clubs should be promoted alongside sampling sports for diverse learning experiences prior to entering the pathway. Talent development environments should also provide players with the opportunity to enter and exit the pathway freely without the social implications of performance decrements around puberty in particular. The learning environment young players are exposed to should feature the key sources of information experienced during a game, allowing for the coupling of perception (what we perceive) and action (what we do). As learning grows, players will become attuned to their unique set of opportunities to act, or affordances, which emerge as they interact with the task, the surrounding environment and their own movement skills rather than recreating a specific

technique. Finally, talent development environments should extend beyond the pathway to allow for the opportunity to advance skill development without selections, incorporating local clubs and communities. Not only does this approach provide those players outside of the pathway with the opportunity to continue their development, it also creates a stronger level of community competition. When the community becomes a key talent development environment, access to resources becomes easier and the transition out of elite status becomes a well-supported process. Collectively these recommendations can help coaches inform their prescription, execution and evaluation of team and individual practices in contemporary cricket.

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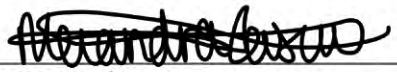
Declaration of Co-Authorship for Chapter 3

In the case of Chapter 3, the nature and extent of my contribution to the work was the following:

Nature of Contribution	Extent of Contributions (%)
Conception and design, acquisition and analysis of data, drafting and revising, final approval of version to be published, agreement to be accountable.	80%

The following co-authors contributed to the work:

Name	Nature of Contribution	Contributor is also a UC student (Yes/No)
Naroa Etxebarria	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
David Pyne	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
Wayne Spratford	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff



Candidate's Signature

Date 10/02/2021

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

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Chapter 3 Perceptions and practices of talent development in women's cricket

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Abstract

Talent development is at the forefront of research in sport, where female athletes remain underrepresented. With ongoing success and rapid participation growth, there is an opportunity to describe and assess talent development in cricket for female athletes. Research in other sports recommends a holistic approach to talent development, where the connection between individual, task and environmental factors is maintained. A series of semi-structured interviews was conducted to draw from the experiential knowledge of 16 elite female athletes and 7 coaches alongside empirical knowledge regarding player development (individual), training task design and talent development environments. Both players and coaches reported positive early learning experiences, linear career trajectories and early entrance into talent programs, suggesting some early specialisation. Exposure to boy's/men's cricket appeared to fast-track skill development in players, and player skill adaptability was considered crucial to expert performance by both cohorts. Training design typically involved functional games-based scenarios, or misaligned task deconstruction in contrast to contemporary skill development practices. Aims for discrete stages of the pathway were ambiguous for both cohorts, potentially limiting the value they provide, and transition between stages appeared fluid to coaches in contrast to the rigidity described by players. Finally, growing professionalism in cricket for female athletes through greater investment, contracts and player support has propagated a skill gap between pathway stages identified by both cohorts, which needs addressing. Closing this skill gap can be achieved by improving coaching practices and support at the amateur levels of cricket to develop the next generation of elite female cricketers.

Keywords

Constraints-based approach, ecological dynamics, female athletes, professionalism, representative learning design

Introduction

Quantifying talent has dominated sport in the last few decades, with an ongoing pursuit to find talented athletes at the earliest possible stage. Despite the detrimental psychological consequences of considering 10-year-olds as 'elite athletes',[1] talent in sport is still founded on identifying talent rather than developing it. Researchers have recently called for more holistic approaches to talent and its development to go beyond a traditionally reductionist view of sport science, which reinforces decontextualised and fragmented knowledge.[2] Many dimensions of human behaviour (e.g., physical, cognitive, psychological, emotional, social, cultural, historical) influence performance and development via continuous interaction. Taking a holistic approach to talent development and incorporating multiple perspectives may assist in this pursuit, with growing transdisciplinarity in sport science research.[3] Recognition for voices and perspectives is required across a diversity of sports settings, such as disabled athletes and female athletes, beyond global sports like football (soccer).[4] One example of this is cricket in Australia which continues to provide greater opportunities for female athletes, but without an

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3.1 Abstract

Talent development is at the forefront of research in sport, where female athletes remain underrepresented. With ongoing success and rapid participation growth, there is an opportunity to describe and assess talent development in cricket for female athletes. Research in other sports recommends a holistic approach to talent development, where the connection between individual, task and environmental factors is maintained. A series of semi-structured interviews was conducted to draw from the experiential knowledge of 16 elite female athletes and 7 coaches alongside empirical knowledge regarding player development (individual), training task design and talent development environments. Both players and coaches reported positive early learning experiences, linear career trajectories and early entrance into talent programs, suggesting some early specialisation. Exposure to boy's/men's cricket appeared to fast-track skill development in players, and player skill adaptability was considered crucial to expert performance by both cohorts. Training design typically involved functional games-based scenarios, or misaligned task deconstruction in contrast to contemporary skill development practices. Aims for discrete stages of the pathway were ambiguous for both cohorts, potentially limiting the value they provide, and transition between stages appeared fluid to coaches in contrast to the rigidity described by players. Finally, growing professionalism in cricket for female athletes through greater investment, contracts and player support has propagated a skill gap between pathway stages identified by both cohorts, which needs addressing. Closing this skill gap can be achieved by improving coaching practices and support at the amateur levels of cricket to develop the next generation of elite female cricketers.

3.2 Introduction

Quantifying talent has dominated sport in the last few decades, with an ongoing pursuit to find talented athletes at the earliest possible stage. Despite the detrimental psychological consequences of considering 10-year-olds as 'elite athletes' (Kirkland & O'Sullivan, 2018), talent in sport is still founded on identifying talent rather than developing it. Researchers have recently called for more holistic approaches to talent and its development to go beyond a traditionally reductionist view approach of sport science, which reinforces decontextualised and fragmented knowledge (Alhadeff-Jones, 2009). Many dimensions of human behaviour (e.g., physical, cognitive, psychological, emotional, social, cultural, historical) influence performance and development via continuous interaction. Taking a holistic approach to talent

development and incorporating multiple perspectives may assist in this pursuit, with growing transdisciplinarity in sport science research (Vaughan et al., 2019). Recognition for voices and perspectives is required across a diversity of sports settings, such as disabled athletes and female athletes, beyond global sports like football (soccer) (Curran et al., 2019). One example of this is cricket in Australia which continues to provide greater opportunities for female athletes, but without an empirical understanding of how they develop and perform, it will be difficult to provide necessary support for future growth. This study explores a female athlete perspective of talent development in cricket as the sport continues to expand.

A holistic approach to talent development considers how each individual, the demands of their task, and surrounding environment shapes the development of talent (Renshaw et al., 2010). Recent developments in skill acquisition science have highlighted that these interactions are ongoing and studying any factor separately may not provide an accurate representation of talent (Davids et al., 2012). The ecological dynamics approach to talent development maintains the interactions between personal, task and environmental by observing them all at the same time (Davids et al., 2015). This approach to studying talent development in cricket for female athletes combines a strong foundation of knowledge with the experiences of elite athletes and their coaches.

The talent development process can begin during childhood experiences with movement and sport through unstructured play like backyard cricket or street soccer (Cannane, 2009). The opportunity to develop new skills, solve problems, and explore creativity is believed to be a key early learning experience which all children, especially young athletes, should have access to (Côté et al., 2007). These positive early learning experiences protect athletes against burning out at a young age (Brenner et al., 2019). Other experiences like sampling a variety of sports simultaneously can develop a diverse movement skill-set like throwing, catching, running and jumping, which transcend the bounds of sports to build physical literacy (Côté & Erickson, 2015). As the foundation of movement and personal development, early learning experiences represent the personal element of talent development in the ecological dynamics framework.

Environmental factors are known to shape individual behaviours and the same interaction is evident between an athlete and their talent development pathway (Martindale et al., (2005). Many sports provide a pathway to elite status through talent programs and providing

different opportunities for young athletes, but there is growing criticism of some of their practices and principles (Koz et al., 2012). As individuals develop at their own individual rate, their skills are likely to fluctuate with biological and psychological maturation at different stages during adolescence (Lee et al., 2014). The difficulty of using physical or performance characteristics during this stage of development to predict future success has been criticised in the past, but junior performances are often the main criteria to enter talent pathways (Vaeyens et al., 2009). If development occurs in a nonlinear way, it should be possible to also navigate a talent development pathway in a similar fashion, by zigzagging between stages and levels (Gulbin et al., 2013). The existing talent development pathway structure for cricket in Australia (Figure 1) appears to be linear, as players typically enter the first stage (Foundation) and gradually progress to the Talent, Elite and Mastery stages without any indication of how to gain entry. Without clear aims for each stage of the pathway or set criteria to qualify for entry, an effective talent development environment may be unattainable (Martindale et al., 2007).

Figure 2. Cricket Australia's (2015) Talent Development Pathway adapted from the FTEM model by Gulbin and colleagues (2013a).

The task element of the ecological dynamics framework relates to how training design can influence learning and skill development. This process is underpinned by a shift in sport science whereby the human body is viewed as a complex, adaptive system that can utilise information cognitive processing (Davids et al., 2003). This information is embodied within the athlete, meaning the sources that each individual searches for and becomes attuned to in their environment could be proprioceptive, haptic, acoustic and/or visual. This shift means that

movements emerge from the interactions between an individual athlete, the information they source from their environment, and task constraints (Renshaw et al., 2009). In other words, what we perceive informs how we move, and vice versa (Warren, 2006). The implications for designing training activities in cricket means that training should provide the same information that batters and bowlers would look for in their game environment, which is often the opposing bowler or batter (Müller et al., 2006). When this information differs substantially from the game-like experience, different and sometimes dysfunctional behaviours can emerge (Pinder et al., 2009). To develop functional movement and problem-solving skills, the same information used in a game should be available at training, but common training practices often fail to do so (Krause et al., 2019; Lascu et al., 2020).

Given the ongoing interaction between a person, their task and the environment, research should capture early learning experiences (personal), talent development environments, and task design to accurately represent talent and its development in a sporting context (Alhadeff-Jones, 2009). In this study, these elements are combined with the experiential knowledge of elite female cricketers and their coaches to provide initial insights into their talent development journey. This knowledge will help enhance approaches to talent development and promote the representation of women in sport, allowing female athletes to prosper in the growing professional landscape of sports such as cricket.

3.3 Methodology

3.3.1 Participants

A representative sample of elite female cricketers and coaches in Australia were recruited to characterise current perceptions and practices of talent development in cricket for female athletes. The participants consisted of 16 elite female cricketers with a minimum 4 years of experience at the state representative level (age 20y-33y, mean=25), and 5 head and 2 pathway coaches (age 34y-48y, mean=43; n=7; 4 male, 3 female) with a minimum 2 years of experience with female cricketers. A head coach is responsible for the elite women's teams while a pathway coach oversees the development of female cricketers throughout the junior stages of the talent development pathway. When combined, the participating cohort represents six of the seven competing teams in the (Australian) Women's National Cricket League (WNCL). To anonymise the participants in this study, a code was attributed to each participant using their

status as an athlete, head coach or pathway coach, their level (state or national) and an identifying number. For example, a state level pathway coach is represented as PCS1, while a national-level athlete is PN1.

3.3.2 Design and Study Context

A transdisciplinary approach to research was taken to investigate the complexity of talent development via recruitment of elite athletes and coaches (Vaughan et al., 2019), combined with the diverse theoretical backgrounds of the authors . A relativist ontology with a subjective epistemological position was taken for this investigation, operating within the interpretivist paradigm where reality exists as an individual interpretation (Levers, 2013). The knowledge and meaning of talent development were generated from the interaction between the participants' experiences, their ideas and the investigators. A qualitative methodology was implemented to capture experiential knowledge from talent development coaches and elite female cricketers. A semi-structured interview protocol was adapted from recent investigations into talent development and empirical knowledge (Martindale et al., 2007). The questions, featured in Figure 2, were crafted by the primary investigator to elicit open-ended responses from coaches and athletes about their personal development, talent development environments, task design and training experiences as characterised by the ecological dynamics framework.

Tailored for Athletes

Q1 What influenced your decision to become a player?
Q2 What was your initial motivation to play: to participate or compete?
Q3 When did you first interact with the talent pathway?

Tailored for Coaches

Q4 What influenced your decision to become a coach?
Q5 What was your initial motivation to coach female athletes?
Q6 What talent development programs are available for female athletes in your state/territory?
Q7 At what stage of the talent development pathway do you first interact with athletes?

Shared Questions

Q8 When was your initial interaction with cricket? What was it like?
Q9 How do coaches develop batting and bowling skills at the elite level?
Q10 Does this change through the pathway with development athletes?
Q11 What are the aims of each stage of the developmental pathway?
Q12Why do you think some people enter the elite system but never progress to the top?
Q13 What role do you think adaptability plays in elite performance?

Figure 3. List of interview questions for both coaches and athletes, detailing targeted perspectives for each cohort.

3.3.3 Data Collection

A letter of invitation was emailed to the High-Performance Manager of each state/territory cricket organisation in cooperation with Cricket Australia. Athletes were then selected randomly from the state contract list and invited to participate in the study. All received a participant information pack which included written and oral information about the aims, benefits and risks of the study, as well as the question guide (Figure 3) before providing their written informed consent. Coaches were approached directly after their state sporting organisation expressed interest in the study to provide insight on the delivery and construction of talent development environments. Pilot interviews were conducted with the National Head Coach and Pathway Coach to review the order, content and semantics of the questions in the interview guide, which was reviewed subsequently and agreed by all investigators. The data from these pilot interviews were not included in the final analysis. The study was approved by the Human Research Ethics Committee of the University and conducted according to the Helsinki Declaration. Once the questions in the interview guide were finalised and consent

forms received, all semi-structured interviews lasting between 20-60 min each were conducted by the primary researcher online or in person in 2018 and recorded on a MP3 storage device.

3.3.4 Data Analysis

A combination of inductive and deductive analysis was utilised, adapted from Martindale and colleagues (Martindale et al., 2007). The inductive approach harnessed hierarchical content analysis through the three stages of coding experience, inductive inference and similarity processes in accordance with Côté and colleagues (1993). Each interview was transcribed verbatim by the primary investigator, followed by open coding of each transcript to identify meaningful information and categorisation of the emerging codes. Given we employed a transdisciplinary approach to research, emergent codes and their relationships were interpreted by the primary investigator and assessed for consistency and similarity by all investigators. The results and discussion sections feature all emergent themes and categories from the data supported by quotes from the interviews, as well as an overview of the hierarchy (Table 1).

A deductive analysis was conducted to compare the literature on talent development and the emergent themes from the participants. The nature of personal, task and environmental factors within an ecological dynamics framework acted as a guideline for themes during the deductive analysis and detailed in Online Supplementary File 1. With a large amount of literature on ecological dynamics and talent development in other contexts, the translation of this work in relation to cricket was a primary resource for establishing the congruence between empirical and experiential knowledge of coaches and players.

3.3.5 Trustworthiness and Reflexivity

Given a focus on complex and personalised problems such as perceptions of talent development, trustworthiness in this context is drawn from Barbour (1998) as “the extent to which the findings are an authentic reflection of the personal or lived experiences of the phenomena under investigation”. Member-checking was performed by asking all participants to review the transcriptions of their interviews, confirming they were an accurate representation of their interview experience (Punch, 2005). Data triangulation was achieved through the combination of inductive and deductive data analysis to capture a more complete understanding of the phenomenon (Knafl & Breitmayer, 1991). This is reflected in sampling of two unique perspectives within the population and integration of existing empirical knowledge in Table 2.

The primary investigator also acknowledges that as an active participant in the research process, the development of the research and participant engagement were influenced significantly (Knafl & Breitmayer, 1991). Prospective reflexivity was necessary throughout the data collection process as the primary investigator is also a coach, a former athlete in a talent development pathway, and invested in the future of women in sport. Prospective reflexivity views the role of the researcher not as a potential contaminant of the data but rather promotes understanding of the significance of their knowledge, feelings and values (Attia & Edge, 2017). Reflections on the cyclical experience of conducting research were conducted regularly as memo writing and journaling, following the notion of Dewey's two-way exchange (Dewey, 1910/2012) that "we do something to the thing and then it does something to us in return (and we, changed as we are, we return to take our next action)". Each subsequent action, was corroborated by all researchers, triangulating the analysis of the data to compensate for any bias (Denzin, 1989).

3.4 Results and Discussion

3.4.1 Personal Development

All players experienced early unstructured play with family and friends in backyards, suburban streets and local parks. For example, interactions with drainpipes and pumpkin patches shaped the batting strokes of some players as toddlers by encouraging them to manipulate the bat or direct the ball away from the pumpkins. Unique problem-solving skills emerged from interactions with skilled siblings to avoid being hit into neighbouring rooftops and houses.

"Pretty much, Pop used to have a drain out the back and it was perfect for the size of a bat so that's how we learned to play the bat [between there] at 3 or 4 years old." [PS4]

"We had a park 100m down the road, and [my brother] would hit me onto roofs and houses, make me go get the ball until I learned where not to bowl." [PS12]

The enjoyment found in experiencing new ways to move was identified as a positive early learning experience by the players, complemented by the opportunities to play multiple

sports. Balancing cricket with other sports like softball, hockey, Australian rules football and soccer became increasingly difficult as players progressed through the talent pathway and training demands increased.

> *"Well, I played heaps of different sports when I was growing up. I played hockey, soccer, golf, athletics and all that. I just wanted to play every sport that you could play at primary school." [PN1]*

While sampling sport is encouraged until 12 years of age (Côté & Erickson, 2015), longer training hours and an earlier start to the pre-season in cricket often overshadowed the enjoyable outlet of other sports, despite being a protective factor against early burnout in youth athletes (Brenner et al., 2019).

> *"Training [for cricket] was more often, longer hours, starting pre-season earlier in June crossed over with things like footy, so [played multiple sports] up until 15/16." [PS1]*

Talent development practices for youth athletes should promote positive early learning experiences like unstructured play and recognise the benefits of developing movement skills in other sports. Currently, structured programs like T20 Blast (Cricket Australia, 2020) are targeted at children under 12 years old to provide positive early experiences with cricket. As the physical landscape of suburbia and play behaviours of children continue to evolve, with smaller backyards (Hall, 2010) and more screen time (Active Healthy Kids Australia, 2018), these programs allow children to explore a modified game of cricket scaled to their level of physical development. It is unclear if engaging in a structured program as a young athlete provides the same benefits of unstructured play on development (Côté et al., 2007), but they can build social interactions, explore movement patterns and problem solve.

As youth athletes engage in structured play, they also have a tendancy to still engage in unstructured practice and play (Cairney et al., 2018). The quotes above suggest that engaging in each type of activity has been complementary to their skill development, and as such, the structures of practice and play should not be considered as a dualism but rather a coupling. The introduction of more structured play opportunities and supportive learning environments may in fact increase engagement when unstructured play is available. While one form of play is not considered more important or beneficial than the other, the opportunity to engage in both should be mediated by not over-committing to only one form.

3.4.1.1 *Boys/Men's Cricket*

Playing boys/men's cricket was another common socio-developmental experience for players but for various reasons. Early interactions with cricket included watching siblings or friends which eventually extended to invitations to play and coaches willingly bending the rules to allow it. Players often stumbled upon the female cricket pathway after being organically drawn to the game. Participation growth has now facilitated all-girls competitions for junior athletes and the implications of not playing boys cricket are yet to be explored. Players and coaches identified that they "could tell who has played boys cricket" in relation to skill development and game awareness.

> *"I don't know why this is but, you can tell who has played boys cricket and who's played girls cricket. And I don't know if it's that you've been challenged but you can challenge a young girl who has always been playing girl's cricket." [PS12]*

The long-term effects of all-girls competitions embedded in the junior cricket pathway will only be seen in the years and decades to come. It may provide a more welcoming platform to access cricket and talent development for girls, which previous generations of cricketers were denied. But this all-girls competition scheme might come at the cost of skill development if the core value of experiencing boys/men's cricket is not preserved.

> *"So, your 12-year-old girl all of a sudden decides that she wants to play cricket and because the numbers aren't huge, before they know it, they're in a state squad. And they don't quite have the experience that a 12-year-old boy might have had." [PCS2]*

3.4.2 Talent Development Environments

Pathway programs differed slightly in each state/county, but coaches provided detailed accounts of their approaches to talent development. A dependence on funding and lack of large participation numbers were identified as limiting factors in some regions, resorting to talent identification over development in some instances.

3.4.2.1 *Pathway programs and player trajectory*

Pathway programs differed slightly in each state/county, but coaches provided detailed accounts of their approaches to talent development. A dependence on funding and lack of large

participation numbers were identified as limiting factors in some regions, resorting to talent identification over development in some instances.

> *"It is different because there isn't much of [a talent development pathway], so we're just starting a talent development program and that was an interesting process. I wanted some talent ID days where I could see as many girls as possible." [HCS3]*

Players typically navigated the pathway programs in a linear trajectory, with the majority of players entering around 12-years-old before progressing through all the age-based stages. In contrast, coaches believed players could move between the stages of the pathway freely. As players reached the end of the age-based stages, many graduated into elite senior programs with a state contract with little indication of how or why it was awarded. The quote below highlights that a linear and rigid progression between stages of the talent development pathway can feel like being 'stuck'.

> *"And then I was pretty much stuck in those programs, it's almost harder to get out than in it seems." [PS3]*

Head coaches indicated program design was longitudinal and flexible to meet the unique needs of talented athletes, but descriptions of selection criteria or pathway entrance requirements were vague. The progression from an aspirational young female athlete to entering the talent pathway and becoming a state level athlete was also obscure, as detailed below. The lack of detail in Figure 2 illustrates that these elements are not known or readily available to other cohorts.

> *"There's a lot of work to be done and our aspirations is that if you're a 13-year-old girl, you should know exactly how to get to the Tigers program and at the minute there isn't that clarity, and we need to get better with the community base sides at least that lead into our talent pathway." [HCS3]*

The linear progression of the players included in this study implies that some may have benefited from early identification, where physical maturation can be confused for advanced skill development (Weissensteiner et al., 2009). However, ongoing access to resources, support and ongoing opportunities for development were only provided to selected players, restricting the development of players beyond the pathway (Pankhurst & Collins, 2013).

"But we lose girls and likewise too, we don't have the opportunity to develop our talent… [we need to] reward the girls at club [level] to give fringe players a chance to play quality competition." [PS12]

If progression from one stage of the pathway to the next is predicated on passing through the previous age-based stage, this requirement might impede the opportunities for players who do not benefit from early identification. It also highlights that development of talent in cricket may be limited to those who enter the pathway before 15 years old, which will become unsustainable as participation numbers continue to grow and an influx of future cricketers places the pathway under greater pressure to produce talent.

A nonlinear approach to talent development, as proposed in previous research, would allow players to freely enter and exit the pathway by providing better talent development opportunities in local communities (Correia et al., 2018). This approach would allow players to enter the pathway at a later stage but with a well-developed skillset that allows them to compete equally for senior elite positions, as often seen in other sporting contexts (Vaeyens et al., 2009). This approach was valued by one head coach, who recognised that diverse skillsets could benefit both the individual player and the team.

"I'm not a massive supporter of early specialisation, I think there's lots of crossover skills that benefit the athlete but also the team." [HCS4]

While there is no practical reason why players cannot currently enter the pathway at a later stage, some entrance guidelines regarding skill competencies could make nonlinear pathway navigation more realistic. To accommodate for the growing population of female cricketers, local clubs should become talent development hubs by providing ongoing development opportunities. This scenario requires well-informed training practices and a collective understanding and expertise for female cricketers.

3.4.2.2 *Aims for stages of the pathway*

To create an effective talent development environment, aims and practices should be aligned throughout the unique programs at each stage of the talent pathway. Mixed intentions were raised by players and coaches regarding the junior stages of the pathway, ranging from building a strong foundation of skill to simply enjoying their early experience with cricket. Despite experiencing the junior stage as athletes, the primary focus of this stage remains unclear.

"Um I mean, going through I probably didn't take any notice. I don't believe so, from my experience and I'm happy to be corrected as well, it's just a perform at that level." [PS12]

Coaches expressed some contradictions regarding the aims for each stage of the pathway, ranging from detailed program designs to nonchalance. One coach felt progression through each stage of the pathway was not necessary to reach elite status, undermining the role of the talent pathway and clashing with the linear experiences of the athletes in this cohort. This indifference may be linked to the inherent reliance on talent identification, where identifying existing superficial physical characteristics is easier than providing ongoing, holistic development opportunities for all players as recommended for effective talent development (Pankhurst & Collins, 2013).

"Not before they move up, I think it's just talent ID, if you've got a 15-year-old where you sort of go wow, they can play, what does that then look like, for me we'd just fast-track them in…if you sort of judge it on your experience of what you're seeing, you don't have to meet certain criteria for pathway development." [HCS1]

Ambiguity surrounding the senior stages of the talent pathway was evident, with players and coaches alike unable to identify aims for the stages despite being heavily involved in them. From fitness benchmarks to advanced technical skills, it is difficult to discern how skill development occurs and what the pathway itself provides from the inherent lack of detail.

"I'm a classic example because obviously I'm playing this level, but I keep getting hounded about making fitness benchmarks. [If] you take away that and you just look at my on-field performances, isn't that good enough?" [PS15]

There may be no specific reason why players proceed through stages of the talent development pathway, a shortcoming that limits the effectiveness of the system and makes it difficult for players on the fringes of the talent stages to gauge requirements for entry.

3.4.2.3 *Professionalism*

The recent evolution of cricket for female athletes was attributed to a rise in professionalism by players and coaches. This process was described as the opportunity to build a career playing sport, supported by increased funding for state and national level programs, and subsequent

improvements in facilities and time allocation for training. The financial support that young players now have to pursue cricket full-time was reflected on by older players, creating more competition for positions within state and national squads.

> *I think seeing the crowds and fans and girls growing up, they can see [WBBL] and women's international cricket on the TV, and it's so much more accessible to them which wasn't the case when I was growing up." [PS8].*

The shift in professionalism extended to coaching staff and sporting organisations after a recently renewed memorandum of understanding (MOU) in 2017, with greater investment resulting in more support staff, full-time coaches and new training structures (Ramsey, 2020). Greater access to quality coaching and facilities as well as growing support to pursue sport through late adolescence and early adulthood have increased opportunities. Greater marketing, broadcasting and exposure for female cricketers, including a stand-alone Women's Big Bash League, has made cricket more accessible to women and created a potential career path.

> *"I think the level of cricket will only go up, even from the 1st to 3rd [Women's] Big Bash [League], with the amount of time people can spend training. Money isn't the be all and end all, but now they've got a stable income and there's going to be incentive for them to keep training." [PS8]*

The behaviours associated with professionalism are yet to reach all players as the rapid onset leaves experienced players with a new challenge, while newly inducted players adapt quickly to the new expectations. Greater marketing, broadcasting and fixtures, including a stand-alone Women's Big Bash League means female athletes in cricket have now become a recognisable brand. The demand for talented female athletes, and what talent looks like, may be influenced by this growth in professionalism as female cricketers become more visible.

> *"And the transitioning between the girls that are just starting to understand what being professional is, you're not professional just because you get paid, it's professional because of how you manage yourself and the choices that you make and some girls, even though they're very talented at cricket, you'd expect them to get to the highest level, they've not adopted those professional type behaviours." [HCS3]*

3.4.2.4 *Skill gap between amateur, state and national athletes*

Growing investment into elite female cricket in Australia has perpetuated a skill divide between amateur, state and national levels of the sport. Both players and coaches outlined that without appropriate support and competition structures to promote ongoing development, there are limited opportunities for talented players to transition between foundation and talent stages of the pathway. Male cricketers benefit from a nation-wide 2nd-tier competition to supplement their development, but the absence of this competition for women further extends the skill divide between amateur and state cricketers. Opportunities to enter the pathway are limited beyond the junior pathway stages to national touring sides as U19s and Australia A.

> *"I think the Australian programs, as they should have, became professional and it got away from state programs and state programs are becoming more professional but it's getting further from U18s… with no second XI and that I think it's really tough. I think when you compare it to the male program, rightly or wrongly, there's just more gaps to fall out of in the girl's pathway." [PCS1]*

The lack of competition structures and support beyond the pathway places the burden of talent development on local competitions, which are predominantly run by volunteers. To overcome the ambiguous purpose of the pathway and help young female cricketers develop their talent, greater investment is needed at the foundation (amateur) level of the pathway.

> *"But what about the girls that aren't just quite good enough to play state cricket but would be with the right training and the right environment. That's where I think the issue is, you need to have something for straight out of school and that gap between there and WNCL, because they're not getting it." [PS15]*

Placing the frontline of talent development in local clubs provides greater access for more athletes and may accommodate for the influx of female cricketers, but it comes with limitations. The lack of support structures and access to resources evident in amateur cricket mean more educated coaching staff and facilities are required alongside cultural change to provide an effective talent development environment.

3.4.3 Skill Development and Task Design

Understanding how coaches implement skill development practices was explored through their training design process, and the experiences of players within those sessions. This was an opportunity to determine any discrepancies between intentions and outcomes between the two cohorts. All examples of coaching practices occur at the elite stage of the talent development pathway, with state/county teams. Expert performance was also considered, identifying adaptability as a key factor and desired outcome of training. Four unique themes highlight coaching aims and underpinning theories, task design in practice, how much the training session represented game play, and how junior skill development differs from senior programs.

3.4.3.1 *Player adaptability as active self-regulation*

Adaptability is as an important element of expertise and can extend beyond the ability to perform under changing constraints of sport, including navigating travel, scheduling, and self-management. Within the ecological dynamics framework, adaptability translates into the concept of active self-regulation, where an individual's actions, perceptions, emotions and cognitions are used to navigate uncertainty (Toohey et al., 2018). The ability to actively self-regulate in uncertain environments on and off the field was emphasised as a characteristic of expert performers by a head coach:

> *"She's been very adaptable and resilient to still play at this level I think, in general of cricket you've got to be very adaptable, I think cricket can be a very cruel game in confidence, so I think resilience and adaptability is a massive part. And from my observations, coming through, a lot of players have to get better at it." [HCS2]*

Players regularly recounted match play scenarios which demanded adaptability given the dynamic nature of cricket and elite competition. To match the demands of game play, active self-regulation should be developed during training. Athletes should be allowed to explore the interactions between their current action capabilities and the intended task outcome, which should influence how practice environments and tasks are constructed (Woods et al., 2020). From both player and coach perspectives, adaptability (or active self-regulation) is a characteristic of elite performers and should be fostered throughout the talent development pathway (Toohey et al., 2018).

Beyond skilful on-field behaviours, player adaptability also arose as adjusting to new training times, match schedules and travel as cricket in Australia continues to progress for female athletes. Players outlined that the demands of being an elite female cricketer are changing and attributed that change to an increase in professionalism:

> *"Very important, I think things always change, whether it's training schedules, even just going from Big Bash [to 50-over cricket], the [performance] demand, the increase in professionalism, the requirements of us, training hours is more, so being able to adapt your life accordingly." [PS8]*

Despite the large role that coaching plays in cricket, coach adaptability was rarely mentioned by either cohort. The ability to navigate coaching, travel and scheduling demands plus the wide range of individuals in teams did not emerge from this question. This omission may have been related to the wording of the question, where elite performance can be interpreted as only on-field or player performances.

3.4.3.2 *Coaching practices*

Technical skill development dominated the focus of coaching aims with little consideration given to tactical ability, mental skills and adaptability despite evidence for their importance (Weissensteiner et al., 2012). Coaches highlighted that they valued a "game-style" approach, which can be viewed as the games-based approach (Pill, 2014) or a style of training that represents game play, which is a combination of representative learning design (Pinder et al., 2011b) and the constraints-based approach to learning (Renshaw & Chow, 2018). There are several similarities between the games-based approach and constraints-based learning including holistic approaches to skill acquisition, recognition of individual differences, and controlling learning design. The key difference is in the construction and intention of learning environments. The games-based approach encourages athletes to explore their movements and problem solve during modified game play while the constraints-based approach is focused on the relationship between a performer and their environment. From the conversation with coaches, their application of a "game-style approach" relied on game play scenarios and open field access to recreate information sources like ball direction, distance and live fielders. These examples align closer to the constraints-based approach than the games-based approach.

"...we're really doing a lot of work that involves probably more scenarios, more game-style learning, learning how to play the game a bit more. Whereas the technical side of stuff we're saying this is what you need, this is how you're [going to] do it, you [have to] do it." [PCS2]

The constraints-based approach simulates the demands of game play to foster learning and development, which goes beyond simply playing the game of cricket. By manipulating constraints such as field size, pitch length, number of fielders etc., players have the opportunity to explore their action capabilities, solve new challenges, and familiarise themselves with information available in several forms (e.g., visual, haptic, acoustic). Successful implementation of this approach is based on providing players with vital sources of information which players would search for in a game, but the activity itself does not need to perfectly replicate the game environment (Pinder et al., 2011b). A learning environment which enables an athlete to think, feel and act as they would during the game may be enough to promote functional and skilled behaviours (Connor et al., 2018).

"[Bowlers] compete against other bowlers on execution, we do scenarios, we get them to do variations and execution, so I think we go okay." [HCS2]

In contrast, the training practices that other coaches described and players experienced at the elite stage of the pathway did not map closely to either the games-based approach or the constraints-based approach. Instead, task deconstruction featured heavily, which consists of breaking skills into more manageable "pieces" to be mastered before practicing them together as a whole (Davids et al., 2007). The concern with examples like underarm throws with tennis balls or getting bowlers to walk on trampolines to 'feel their action' is that the connection between what a player perceives at training, and then how they subsequently act, differs greatly from the demands of a match environment (Pinder et al., 2011a).

"So, you do a lot of basic drills, where you're not getting a bowler coming in at you but you're just dropping balls or getting little underarms or little over-arms to just change the position of a foot or a head. [PS11]

When using a ball projection machine, batters become attuned to the different, non-representative information and do not have the opportunity to harness other sources of information that may promote functional batting performance. As coaches seek to improve match performance by building skills which transfer between the training and match environments, omitting more representative sources of information such as the kinematics of

an approaching bowler may limit the batter's ability to identify and/or utilise that information in their performance environment (Regan, 1997). Batting against a ball projection machine may have some learning outcomes, but it is likely to promote different movement solutions which do not result in runs scored in a match. A reliance on bat-ball contact, ball flight and absence of consequences is also more characteristic of amateur skill levels (Connor et al., 2018).

> *"The bowlers get stripped right back to walking on trampolines and getting a feel for their particular action, and what they need to do to get that right, batters just through front foot, back foot shots, seam, spin, but technically becoming very aware of when they execute well, what position they need to be in". [HCS1]*

This quote details how bowlers experience training tasks, making them acutely aware of their movements by deconstructing their action into smaller components. This approach may inhibit the emergence of their regular bowling action because it increases the cognitive load of the athlete during a task which likely occurs subconsciously according to recent skill acquisition perspectives (Davids et al., 2013). This example, and the batting tasks outlined above, highlight a misguided application of either the "games-based" or constraints-led approaches within elite training environments. Evidently, coaches need help understanding how task design influences skill development.

3.4.3.3 *Task design for skill development*

Cricket features an open field, live bowlers and batters, a fielding team and substantial amount of contextual information, which influences how players think, feel and act. When these sources of information are absent in the training context, the skills developed may not suit the demands of elite match performance (Pinder et al., 2011a). Players described physical environmental limitations such as indoor training facilities which made it difficult to understand their skill execution and also limited how well training represented the game environment. For example, striking a ball into a nearby net gave them limited indication of whether the shot was a run, a boundary, or loss of wicket.

> *"I think the most difficult thing is training indoors, you play outdoors, and you've got this much net to play with so you can't actually see where the ball goes. It's funny because we do competitions, batters v bowlers, and if batters get out, they have to do five push ups or if the bowlers get hit for*

four, they have to the push ups but in a net situation, who knows what's happening." [PS1]

Some adaptive coaching practices were also detailed. The use of game-specific scenarios was common among head coaches, highlighting that recreating the emotional, visual and physical demands of match play within an enclosed environment is difficult. Coaches also opted for activities with real-world outcomes and environments such as an open field or on a turf wicket whenever possible, allowing players to understand the consequences of their actions as runs and/or wickets. When restricted, technology such as looped video feeds were harnessed to provide personalised feedback to bowlers while they competed with live batters. By placing the responsibility of skill development on the way a task is designed, players can develop their autonomy and adaptability, or active self-regulation (Woods et al., 2020).

"[bowlers] will have certain nets that are in the contest against batters. We're having their footage filmed and on a 10 sec delay so when they're in the contest, they can look at their technical still, they normally go back to their default action which is quite frustrating." [HCS3]

"But we're trying to really engage them and help them with what their fields are and how they execute so… we've got the Test match game, we had a workshop with that where they set fields and talked about fields and that was really good, took me back to my childhood too." [PCS1]

Maladaptive practices, such as the use of a tabletop board game to develop bowling tactical skills, were also present in some coaching practices. Bowling skill does not occur in isolation and their outcome success is based on interactions between the bowler's execution, batter's skillset, surrounding fielders and chosen field setting, contextual information about the game (runs required or wickets taken), and the desired outcome of either restricting runs (dot ball) or creating a wicket-taking opportunity (Lascu et al., 2020). It is difficult to see how moving figures in a board game begins to simulate this unique but crucial interaction. Creating a training environment which helps players think, feel and act as they would during a game has proven difficult for coaches at various levels of cricket in the past (Low et al., 2013). While not all coaches grasped the underpinning concepts of the games-based approach, they appear to recognise its value. Ongoing education opportunities and more integrated research would benefit both coaches and their athletes.

3.5 Conclusion

This investigation provides insights into talent development for female athletes in cricket. Through the ecological dynamics lens, the role of socio-developmental experiences, talent development environments, and task design for skill development, have been identified to help shape the future of cricket for women. The female athlete experience in this cohort typically engaged in early unstructured play, sampled sports, and participated in boys/men's cricket with the help of supportive social agents. Early learning experiences for future female cricketers may look different with the increasing prevalence of all-girls competitions and structured play programs. However, the benefits of engaging with boys/men's cricket should be investigated further. Ambiguity on the purpose of the talent development pathway also makes it difficult to determine how it impacts female cricketers. Without a clear understanding of how and why athletes are given talent development opportunities, the pathway system may not be effective enough to sustain the influx of future female cricketers. As professionalism continues to improve and playing cricket becomes a viable career choice for young female athletes, there will be greater demand for talent development opportunities.

Additional support and investment at the community cricket level may have the largest impact on the future of women's cricket. If the first talent development environment youth athletes can access is their local cricket club, talent development should occur within and beyond the talent pathway. This requires quality coaching practices and even at the elite level, training design is misconstrued. There is a demand for training environments which simulate the demands of the match environment, but coaches complained about the difficulty of understanding how to recreate them. To promote athletes who can adapt to their environment, or actively-self regulate, coaches should ensure that the relevant sources of information which athletes search for and utilise during a match are available in training. Coaches should also use an open space as often as possible permitting skilled behaviours like batting and bowling to emerge from interactions with the task and environmental constraints rather than deconstructing them. The demand for more ongoing, accessible, and informed coach education is evident, but future investigations are needed to provide a greater evidence base for constraints-based learning in cricket.

3.5.1 Practical Implications

3.5.1.1 *Player Development*

As the sport grows and opportunities to access talent development become difficult to access, positive learning environments beyond the pathway are needed for those who are not identified at an early age. Accommodations for nonlinear development should be made by normalising fluid movement in and out of the pathway, or between foundation, talent and elite stages but it is possible that coaches and sporting organisations do not have the necessary understanding of ecological dynamics to invest in a constraints-based approach to coaching and talent development. Until this understanding is established through coach education, the implementation of holistic talent development practices is likely to remain limited. The rise in participation for women and girls in cricket has generated female-only competitions to increase grassroots engagement but they might not yet be strong enough to foster development. The specific elements of boys/men's cricket that contribute to the advanced skill development and awareness that players and coaches noted are currently unknown. It is integral that all stages of the pathway, from the grassroots to senior adult competitions, promote the development of adaptability, which is critical for expert performance in women's cricket.

3.5.1.2 *Training Task Design*

Coaches highlighted the difficulty of achieving representativeness at training, reflected in the deconstructed approaches to skill development and practices. The disparity between the philosophies of constraints/games-based approaches and the practices implemented by coaches appeared counterintuitive for developing problem solving and adaptability. It is unclear whether the disparate practice stemmed from a lack of understanding of the philosophy, or a lack of access to appropriate resources and training environments for its application. Practices should maintain the connection between perception and action by presenting key sources of information that would normally appear during a game in the training environment, with the freedom for players to explore movement and solve game-related problems.

3.5.1.3 *Talent Development Environments*

Coaches and players struggled to identify the aims for each stage of the pathway, making it difficult to maintain a coherent message or provide ongoing and holistic development. While it is difficult to illustrate the complexity of cricket skills in simple guidelines or benchmarks,

the absence of clear aims or objectives throughout the pathway creates a problematic reliance on intuition to decide which players continue through the pathway. Better support and preparation for national and state/county players as a result of growing professionalism in the sport is contributing to a gap in skills between the foundation and talent stages of the pathway. To provide junior and amateur senior players in the foundation stage with the skills to cross this gap, a greater emphasis needs to be placed on skill development in amateur club competitions. If amateur club coaches are supported in developing evidence-based practices, more players would have access to an effective talent development environment despite being outside of the talent stage of the pathway.

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3.7 Tables

Table 1. Hierarchy Chart for Emergent Themes

Dimension	Sub-theme 1	Sub-theme 2
Socio-developmental experiences	Initial interaction	Early unstructured play
	Sampling sport	Transferable skills Limitations
	Influences	Family Right place/right time Positive experience
	Boys/men's cricket	Early engagement Competitive
Talent development environments	Aims for stages	Junior Foundation of skill Fun Progression
	Drop out factors	Dedication & drive Natural talent Life ambitions Sacrifices.
	Initial entry	Before 15yo
	Trajectory	Linear Re-entry
	Professionalism	Training Investment Memorandum of Understanding (MOU)
	Gaps	Skill development for amateurs Growing gap amateur vs state & national
Task design	Coaching	What they aim to do
	Developing skills	How they do it How representative it is Junior
	Adaptability	Player Coach

Table 2. Model of Ecological Dynamics in Cricket.

Element	Key Themes	Key Concepts	Key Papers
Person	Nonlinear Development	Each individual develops at a unique rate	Chow, J. Y. (2013)
	Maturation effects	Early physical growth with the onset of puberty can be confused for advanced skill development and influence selections in junior sport.	Wattie, N., Schorer, J. and Baker, J. (2015)
	Early identification	Despite limited predictive power, the search for physical characteristics of talent at a young age still dominates talent practices.	Koz, D., Fraser-Thomas, J. and Baker, J. (2012)
	Socio-developmental experiences	Positive learning experiences can foster lifelong engagement in physical activity and sport.	Weissensteiner, J., Abernethy, B. and Farrow, D. (2009)
	Unstructured play	Development begins in yards and local streets through creative play, building social, emotional and physical skills.	Côté, J. and Erickson, K. (2015).
	Sampling sport	Participating in multiple sports can promote skill development through sampling diverse movements and problems to solve.	Côté, J., Baker, J. and Abernethy, B. (2007)
	Social agents & interactions	Influential factors at a young age include parent involvement and the presence of siblings or other play partners.	Côté, J. (1999). Warmenhoven, J., Weissensteiner, J. R., & MacMahon, C. (2020).
Task	Skill acquisition	Humans operate as a complex adaptive system with the ability to self-organise, bypassing cognitive processing to operate organically within the person-environment relationship.	Davids, K., Araujo, D., Vilar, L., et al. (2013)
	Perception-action coupling	Movement is informed by visual information in the environment and the potential action capabilities of the person. This occurs vice versa as well, and is inextricably linked.	Pinder RA, Renshaw I and Davids K. (2009)
	Affordances	The opportunity to act emerges based on perception-action capabilities, where a player must recognise the opportunity and believe they are equipped with the skills to perform it.	Gibson JJ. (1979). Araújo, D., et al. (2019)

Element	Key Themes	Key Concepts	Key Papers
	Representative learning design	Developing skills in an environment which fails to simulate the demands of the performance environment (game) may limit skill transfer or effectiveness.	Connor JD, Farrow D and Renshaw I. (2018) Pinder RA, Davids K, Renshaw I, et al. (2011) Brunswik E. (1955)
Environment	Talent development environments	Long term aims, development over 'early success' and coherent messages for holistic development are hallmarks of effective talent development environments (TDEs).	Martindale R, Collins D and Abraham A. (2007)
	Pathway trajectories	Elite athletes reach their elite status through 'zigzagging' patterns, rarely following a linear path, and often compete in concurrent stages.	Gulbin J, Weissensteiner J, Oldenziel K, et al. (2013)
	Early vs late pathway entrance	World-class athletes enter international space at a later stage and sport-specific loads & success during adolescence are poor predictors of success at top level of chosen sport.	Vaeyens R, Gullich A, Warr CR, et al. (2009) Gullich A and Emrich E. (2006)
	Impacts of specialisation	Increased dropout rates, likelihood of burnout injury and socially maladaptive behaviour increases when playing only one sport.	Brenner JS and AAP Council on Sports Medicine and Fitness. (2016)

Chapter 4 Foundations and effects of professionalism

4.1 Abstract

As participation and performance in sport for female athletes continues to improve, the rise of professionalism is yet to be fully realised. To understand professionalism in sport and how it effects female athletes, a grounded theory approach was taken with elite coaches, past players and administrators from Australian and international cricket and several other sports. According to coaches, players and administrators, an athlete behaves professionally through their attitudes and values, but a professional athlete is defined by their pursuit of sport as a profession and being paid accordingly. Sporting organisations are responsible for remunerating female athletes for their professional performances and behaviours either financially, or by providing access to all necessary resources including quality coaching and support. Women's sport presents an opportunity for sporting organisations to invest in their female athletes by providing equal opportunities for visibility, recognition, and liveability to inspire future generations of female athletes.

4.2 Introduction

As sport becomes a more viable career path for some athletes, the professionalisation of sport and how this impacts female athletes is an important consideration. Past advancements in professionalism for female athletes have occasionally featured in the media, but little academic research has examined the conceptualisation of professionalism. At its core, professionalism stems from an absence of amateurism, which has evolved from the Latin derivative "to love" to "to do something for the love rather than the money" (Amateur, n.d.). The attribution of payment to supplement a love for the game is believed to incite a greater commitment to preparation and performance alongside club loyalty, but the basis of professionalism is still up for debate (Billing, Franzén, & Peterson, 2004).

The debate of professionalism dates back to Roosevelt (1890), who viewed amateurs as Americans working hard towards a regular calling or a profession which, in contrast, aligns with the English definition of a professional. From here, amateurism has been associated with the lack of extrinsic reward and pure enjoyment of a pursuit rather than the absence of financial gain (Dunning & Sheard, 2005; Vanderzwaag, 1977). An erosion of amateur behaviours and attitudes is also believed to form part of the professionalism process (Kjær & Agergaard, 2013).

Being remunerated for work performed, or on-field performances in the sporting context, appears to be the current criteria for professionalism with gradual advancements in paid contracts throughout the history of women's sport. Events like the US (Tennis) Open in 1968 when amateurs and professionals first played in the same tournament heedlessly devalued the women's game, with differences of US$11,000 in prize money and less tournaments to play in between women and men. Nine female tennis players boycotted the tournament and created their own, with $1 contracts to secure their professional status (Carayol, 2020). This initiative quickly turned into the first all-female tennis tour in 1971, advertising strong and confident female athletes at odds with the perceptions of females at the time. The structures built 50 years ago created the platform to reward a recent winner, Ash Barty in the WTA Finals in Shenzhen, China with US$4.42 million (Fitzgerald, 2019).

In other sporting contexts, monetary remuneration has been treated very differently. The experiences of the US Women's National Soccer Team in their public pay dispute with the US Soccer Federation provides another example of pay disparity, despite their striking performances, revenue and audiences. A court bid for US$6.7 million in backpay was ultimately lost on the basis that contracts were negotiated separately for the women to provide support structures like paid parental leave, pregnancy leave and child-care assistance "which are not provided to the men's national team" (Gajanan, 2019). The fundamental concern for the bid was the disparity in "pay to play" payments, where the monetary figure for friendly and competition matches for female athletes was lower than their male counterparts. With no intention of providing pay parity despite various payment structures, this internal dispute was escalated by the growing societal pressure for equal treatment of women in professional spaces, or at least it appeared to be.

While it is expected that each sport will have an independent monetary remuneration for their female athletes, a recent Sporting Intelligence (2017) survey highlights a marked difference between sports, potentially shaping the career pursuits of young female athletes. In Australia, athletes competing in the Super Netball were purportedly receiving ~ US$ 52,000 with some variance across the 80 players in 8 teams. While this figure pales in comparison to the WNBA, with female basketballers in the United States receiving ~ US$ 75,000, this amount is only a portion of the potential salary for a NBA rookie drafted in last place, who has the potential to earn $1.3 million in their first year (Rollins, 2018). For seasonal and growing sports like the

Women's Big Bash League (WBBL; cricket) and AFLW (AFL Women's), salaries range from US$ 9,500 to US$10,500, which is likely related to the shortened 3-month duration of their competitive season. The benchmarks for measuring successful women's sports also vary substantially, making it increasingly difficult to assess progress towards professionalism (Kjær & Agergaard, 2013). As an inherent progression to the next stage of professionalism is rarely evident for women in sport unlike their male counterparts, a combination of attendance numbers, revenue, equal funding in comparison to male athlete counterparts, the number of available contracts, and liveability based on the value of contracts, are used to assess women's sport. Aside from an emergent but overshadowed social media presence, information about professionalism in sport for women remains limited in a research context (Sherry & Taylor, 2019).

Funding allocation and access to resources is the initial process of remunerating professionally behaving athletes, which can significantly impact talent development. As the benchmark of equality in sporting programs, the Title IX law in the USA mandates the equal division of resources between men's and women's programs, with sports like women's professional soccer in Europe believing this is only way to ensure their competition becomes sustainable for its athletes (Williams, 2006). A need for players to access strong support structures was also highlighted in a report into the professionalisation of women's cricket by Hickey and colleagues (2016). An ongoing lack of recognition for the personal and professional needs of women cricketers was identified. A second issue in Australia was the role of the Australian Cricketers' Association in helping athletes build careers beyond the sport to compensate their ongoing low remuneration, and state-based support staff for physical and mental preparation. To help offset the demands of preparing to play at a professional level and avoid "burning the candle at both ends" (Australian Associated Press, 2016), an Australian state cricket team (NSW Breakers) provided full-time contracts for their domestic cricketers a year in advance of the reviewed memorandum of understanding in 2017. After including female cricketers for the first time, an 150% pay increase was offered and the existing domestic competition (WBBL) progressed into a standalone competition.

Professionalism for female athletes therefore cannot occur without significant support and reliable financial structures from state and national sporting organisations. In turn, talent development for female athletes is predicated on how much a sporting organisation is willing

to invest by providing such support, structures and resources. While current conceptualisations of professionalism revolve around the payment of players, a deeper understanding for other elements such as the erosion of amateur attitudes and beliefs, professional behaviours in players, and the process of sporting organisations recognising their female athletes as professionals is needed. This study aims to build on the knowledge and experience of women's cricket in Australia and guide other sports with emerging female athlete cohorts to reach a state of professionalism. The perspectives of coaches, past players and administration from cricket are complemented by insights from overseas (New Zealand, Ireland, England, USA) and administrators from other sports (rugby union, cycling, Australian rules football, basketball, football). By identifying critical elements of the pathway to professionalism, other sports with emerging female cohorts could direct their efforts to improve professionalism within their means and provide a broader, more supportive sporting landscape for female athletes of the future.

4.3 Methodology

A sample of 7 elite cricket coaches, 5 past players and 7 administrators (n = 19; 16 female, 3 male) from Australia were invited to conceptualise the rise of professionalism in cricket for female athletes. Elite cricket coaches provide an informed perspective on current operations and structures in cricket, complemented by the historical account of how women's cricket has evolved from past players. This allows for the characterisation of how and what has changed, and at what level, or with what provisions and support, can female athletes be considered professional athletes. International cricketing perspectives were provided by 2 past players from England, one administrator from Ireland and one administrator from New Zealand (n = 4; 3 female, 1 male). This sample was complemented by one representative from each sport of basketball, Australian rules football, cycling, football (soccer) and rugby union (n = 5; 4 females, 1 male). Participants were required to have a minimum of 3 years experience in coaching female athletes or administration, while past players required a playing career of 5 years minimum. Administrators included board members and full-time employees of national sporting organisation, an employee of the players' association, and employees of professional sporting teams. Elite coaches were recruited from state or national level sides and two participants were independent consultants for women and diversity in sport.

4.3.1 Ontology and philosophical perspective.

The philosophical perspective taken during this research was pragmatism. This perspective was chosen because it recognises that there is no single way of understanding the world, or that no knowledge claim can be documented as providing the truth because all knowledge results from engaging with the social world (Biesta, 2010). A relativist ontology was applied to this chapter due to the belief that the purpose of science is to understand the subjective experience or reality and multiple truths (Denzin & Lincoln, 2005). As professionalism is a socially constructed concept with an ambiguous and unclear definition, developing a theory of professionalism should be approached from a relativist and pragmatic position. As multiple grounded theory perspectives exist, a Straussian perspective was taken during this research as it is underpinned by a relativist position and believes that "the researcher constructs theory as an outcome of their interpretation of the participant's stories" (Mills et al., 2006).

4.3.2 Design and study context

Initial participants were purposefully sampled for their involvement in organisational change likely to influence professionalism within sport i.e., board members and administration staff, or their experience within sport as it shifted towards professionalism i.e., coaches and past players (Corbin & Strauss, 2008). Further participants were recruited using a snowball technique until conceptual saturation was reached, when categories, concepts and the relationships between them were fully accounted for (Green & Thorogood, 2004). Snowball sampling is where study participants recruit future participants from among their acquaintances. At the end of each interview, the participant was asked to suggest two other people that they considered knowledgeable or experienced in the topic of professionalism in women's sport, who were then contacted by the initial participant and if interested, subsequently recruited.

A semi-structured interview protocol was designed to capture key elements of attitudes and values, payment structures and support structures as well as defining professionalism, changes in sport scheduling and fixtures, organisational agreements including a MOU or collective bargaining agreement, and the sustainability of a career in the sport. The question guide was developed by the primary researcher and reviewed by the research team of 3 experienced researchers. The guide was then piloted with an Australian cricket administrator and analysed prior to commencing the research project. The question guide featured in Table

3 was approved by the research team and designed to elicit open-ended responses from all participants to ensure their unique perspectives contributed to the conceptualisation of professionalism in sport for women. If a response was initially limited to "yes/no", prompt questions were used to encourage clarification such as "if so, how and/or why?".

4.3.3 Data Collection

A letter of invitation was sent to individuals at state and national cricket organisations to recruit participants from cricket in Australia. Snowball sampling was then applied to the Australian cricket community where participants recommended future subjects from among their networks, resulting in a sample of international participants and representatives from other sports. An information pack was provided to each participant detailing the aims, risks and benefits of the study along with the question guide (Table 3) before informed consent was requested and provided. The study was approved by the Human Research Ethics Committee of the University of Canberra (21732019) and conducted according to the Helsinki Declaration. Upon receiving all consent forms, all semi-structured interviews were conducted online with the primary investigator for 30-60 mins and recorded on an MP3 storage device. For confidentiality purposes, an identification code was assigned relating to the primary sport, role (coach or administration), location (international or domestic) and athlete status of the participant. For example, for a head coach (C) working in domestic (D) cricket in Australia, who also played at the elite level of the sport in the past (P), their identification code is CricketDCP1.

4.3.4 Data Analysis

In accordance with the Strauss and Corbin's (1998) version of grounded theory, data analysis consisted of a progressive coding technique using the analytic techniques of open-, axial- and selective-coding. Data analysis commenced the moment data collection began with the initial sample of administrators, coaches and past players from Australia and each interview was transcribed, initially coded and categorised prior to commencing the next interview. The initial data was subjected to open and axial coding, which filtered the data to identify concepts and their properties before reassembling them into categories and related subcategories. Other perspectives, including international cricket and diverse sporting backgrounds, were sampled to compare, test and evolve the developing theory of professionalism emerging from the

domestic cricket experience and perspective. Each sport represented in this sample is currently experiencing the professionalisation of their female athletes to some degree, and they provide critical insight into the development process of professionalism as it is occurring. Constant comparison between data sets was maintained throughout the analysis between concepts, categories and relevant literature to construct a grounded theory of professionalism in women's sport. The concept of professionalism was defined by the participants, with categories outlining the existence of player and organisation behaviours that interact to create professional sport and athletes. The grounded theory of professionalism outlining athlete and organisational views of professionalism and detailing the challenges and opportunities that exist in women's sport, are presented in Table 4.

4.3.5 Trustworthiness and Reflexivity

Trustworthiness in this context is drawn from Barbour (1998) as "the extent to which the findings are an authentic reflection of the personal or lived experiences of the phenomena under investigation", to adequately reflect the complex and personalised nature of professionalism. All participants performed member-checking by reviewing the transcript of their interview (Punch, 2005). Data triangulation was also achieved in multiple ways: space triangulation by collecting data about the same phenomenon in two or more settings to investigate consistency across sites; person triangulation by collection information from more than one level of persons (multiple roles within an organisation); and researcher triangulation by involving the research team in the analysis of the data while categories and codes were being developed (Curtin and Fossey, 2007).

The primary investigator is considered an active participant throughout the research process, and this is acknowledged as having a significant influence on participant engagement and the research development (Finlay, 2003). Prospective reflexivity was necessary throughout the data collection process as the primary investigator is also a coach, former athlete and invested in improving the future of women in sport. Prospective reflexivity views the role of the researcher as understanding the significance of their knowledge, feelings and values on the research performed (Attia and Edge, 2017). This is mediated through the process of memo writing, which is performed with the raw data to explore and theorise the emergent patterns while also increasing the level of abstraction of the researcher's analytical ideas (Charmaz, 2006). Memos are considered a fundamental link between the emergent theory and the data by

recording the creative process of theory development. Reflection was also maintained throughout the research process by recognising that a two-way exchange occurs, "we do something to the thing and then it does something to us in return (and we, changed as we are, we return to take our next action)" (Dewey, 1910/2012).

4.4 Results and Discussion

4.4.1 Defining professionalism

At first, participants found it difficult to pinpoint a definition of professionalism, with many trying to avoid the 'default definition' of players being paid. Evidence that all cohorts subscribed to the paid remuneration approach to defining professionalism appeared in off-hand comments and detailed descriptions of payment structures, demonstrating that any conceptualisation of professionalism should contain this element. The importance of paid remuneration was believed to be overstated by some participants, instead using a combination of attitudes, values and behaviours to describe what a professional athlete does. Attitudes and values are discussed as a unique sub-theme stemming from Question 3 in the interview guide (Table 3), followed by discussions around sport being a full-time job or a profession and observed societal pressure to be classified as professional.

> *"If we talk about professionalism, we automatically think about the players and what professionalism means to the players. And of course, professionalism from the players perspective could be that they're paid. That's an important distinction between an amateur athlete and a professional athlete. But I actually think more broadly, professionalism is the approach." [RugbyDA1]*

4.4.2 Category 1. 'Behaving professionally' – professional behaviours of players as recounted by coaches, past players and administrators.

4.4.2.1 *Attitudes and values*

When asked to describe specific attitudes and values that define professionalism, responses varied based on the perspectives of the participants. For the past players, a change in attitudes and values never occurred, highlighting that there was always a commitment to "*do everything they can to the best of their ability, all of the time*" (CricketDCP1). To the players whose careers were no less successful than their future counterparts, the lack of remuneration, resources and time to commit to sport as a career was not seen as an amateur approach, but rather a

circumstance they needed to overcome to perform. Conversely, one coach highlighted that "*you can be paid and still certainly not be a professional*" (CricketICP1), highlighting the importance of values and attitudes in the professional sporting realm and that they may not always be prominent in paid athletes. The suggestion by Kjær and Agergaard (2013) that an "*erosion of amateur attitudes and values*" occurs in the process of professionalism did not seem apparent for past players, but characteristics like determination, commitment and resilience featured often in responses from all cohorts.

Coaches observed that experienced players, who have been in the high-performance cricket system as professionalism has advanced, have not always adapted well to changes in time commitment, expectations and roles within the team. Administrative staff highlighted that attitudes and values within an organisation extends to the way players are treated, and the opportunities they are afforded. If an organisation is committed to the professionalisation of their female athletes, this value is reflected in actions and policy, including their approaches to talent development and player wellbeing. Within Australian cricket, the professionalisation of female athletes was on the national sporting organisation's agenda from 2012, with action taken in 2017 during a renegotiation of the MOU between players and the organisation. This turning point defined the era where women's cricket transitioned from a hobby to a profession.

4.4.2.2 *Sport as a full-time job or profession*

The opportunity to craft a profession out of playing sport, where preparing and performing for that sport becomes a primary source of liveable income, was another significant discussion theme from all cohorts. Participants drew comparisons to other professions like teaching and coaching, where a living can be made from becoming skilled in and pursuing such careers, and reflected that a label of 'semi-professional' should be attributed to sports in which this standard cannot be maintained yet. Other sport representatives noted that as an entry-level job, a paid sporting role in a professional organisation serves as a good career position for young athletes who are graduating high school and/or entering university but beyond that, it simply presents as an alternative part-time job.

> *"I would consider them semi-professional. And I honestly think it does come down to the money because to me the difference in professionalism is whether or not you can call at your job or whether or not you can call at your part time job." [CricketDAP3]*

"I'd say that [basketball] is nudging to become professional in terms of all the athletes being paid for a six-month job. That's a pretty decent salary, not wow you're going to set yourself up for life. You're not." [BasketballDC1]

A growing time commitment and increased training loads were associated with the increase in professionalism for women in cricket, with little room for "*excuses not to prepare and perform at their best*". Past players often took recreational leave from their 'day jobs' to compete in international tours and represent their country in their chosen sport and some even enjoyed not being a full-time athlete. While taking leave is no longer an expectation, the majority of participants clearly outlined the need for cricket and other sports to reach a stage of professionalism where playing sport becomes a full-time job or profession. This is the ultimate responsibility of their respective state and national sporting organisations.

"[Historically] some [players] would be almost 100 percent focused on cricket, but not many of them. A lot of them were still studying, some still are as well. A lot of them were still working so they'd have to take leave to go on tour." [CricketDAP3]

"But personally, I enjoyed that I didn't, I wouldn't want to be a cricketer or a footballer 24/7. I quite like the going to work, perhaps a little bit less pressure. And you weren't in the spotlight of "that's an England cricketer" you know, a little bit now." [CricketICP2]

This perspective differs greatly from the reality of past players, who often balanced a career alongside their national sporting duties and found creative ways to prepare individually. The flexibility to work and play sport is likely one benefit of the current path to professionalism, with some coaches and administrators noting that transitioning out of sport has often been difficult for male athletes. This flexibility comes at a cost, with training 'lock out' hours between 10am and 4pm making it difficult for players who are solely supported by, and dedicated to cricket, to reach their full potential. If this flexibility ever dissipates, one coach believes that the opportunity to unwind from cricket and pursue another passion will be missed by players.

"So I was a postie for the most my cricket career, they were really good giving me time off. I think it teaches you different values.. I used to take my neighbour's dog to the local park and put tin cans down and that was my shuttles. Throw the ball and get as many shuttles in before the dog came back. We didn't have any of these set programs but you improvised and I

don't think any of us wanted it any less playing for your country." [CricketICP2]

"I think they'll really miss that flexibility where they can go off and do work then come back and focus on cricket. It does alleviate problems." [CricketDC1]

4.4.2.3 *Societal pressure to be (seen as) professional and stigma*

The growing presence of women's sport in social media and feminism worldwide has placed a greater pressure on players and organisations to be seen as professional. With "*a societal shift to see women as equal*", the societal pressure on female athletes weighs on their online presence, fan accessibility and expectation to be a good role model as a fundamental part of being a female athlete. From the accounts of past players in particular, it appears that a stigma towards women in sport continues and this is something that current athletes must continue to overcome. To be considered professional, players must change the way they are perceived in society, as seen by the use of male-only pronouns such as "manhood" and "man" in early studies of professionalism two generations ago (Vanderzwaag, 1977).

"And we have to do a lot of hard work to change perceptions from the viewing audience." [RugbyDA1]

"And there's still that old school mentality of "bloody women's cricket", what do the girls know, but speaking with the coaches, they are actually really open to the potential that girls have." [CricketDCP2]

A tokenistic approach to women's cricket in the past was perceived by many past players and coaches, with some international participants noting its ongoing presence in their organisations. In other sports, the lack of diversity and provisional inclusion of women in some leadership circles, or positions of power, have resulted in entire systems that are not designed to accommodate female athletes. While the pathway programs, academies and development teams are well intended, one administrator questioned how much some sporting organisations value the voices and experiences of their female athletes.

"Women are beginning to be included, though I would ask the question how valued they feel that their voices are." [AFLDA1]

"Oh, absolutely. Certainly, around the women's game. It was always a little bit of token. It was just "get on with it" kind of attitude. You have what you have, be happy with it." [CricketIA1]

One cricket administrator recognised a process of de-stigmatisation over five to ten years, drawing comparisons to tennis and reverence for Serena Williams as one of the best tennis players in the world, rather than the distinction of 'female tennis player'. Another cricket administrator highlighted that even within sports like cricket, male athlete counterparts have held a perception that female athletes are not as capable in the past, but this has changed as the WBBL has evolved with open and genuine support. The way organisations view their players across sports was considered far more progressive and reflective of the professional behaviours of female athletes within cricket, emphasising that differences between male and female athletes need to be embraced rather than drawing constant comparisons.

"I think also to, women's cricket has been destigmatised in the last 5 to 10 years. Hopefully we are past the point of comparing men's and women sport and just enjoying it for what it is." [CricketDA1]

"When we first started the male players were like we don't like this, that's shit, they are terrible, couldn't hit, there's no chance there any good…then on possibly the hottest day on record, 75% of our men's team players and coaches came to watch our WBBL team." [CricketDA4]

4.4.3 Category 2. 'Turning players into professionals' – the role of sporting organisations in improving professionalism

"And for many of those 80 years there wasn't much progression but then there was through individuals. I would say that there are really significant individuals who have contributed acutely to the game, whether that's an administrator or a player or both. And then probably what's happened over the last 5 to 10 years is that instead of it being an individual movement, it's become a group movement which has probably accelerated it even quicker." [CricketDA2]

4.4.3.1 *Recognising female athletes as professionals through remuneration*

In 2017, a MOU between Australian national-level cricketers and their national sporting organisation included female athletes for the first time. This development played out publicly in social media for the first time, with the normally private negotiations receiving ongoing criticism from current and past players, commentators and the general public. A MOU is a

preliminary written agreement, shaping the language and framework for future formal contracts to recognise female athletes with their respective governing bodies. For the Canberra United team in Australia's W-League (football), this meant partnering with a bid to start an A-League (men's) football team in the city, which "could include significant raises to player salaries, sharing elite-level facilities and coordination across commercial opportunities." (Tiernan, 2018). But an MOU is only an in-principle agreement, and all or none of these changes could arise for female footballers as the bid progresses. Administration staff highlighted the significance of the MOU in 2017 but coaches and past players struggled to detail why it was significant other than new contracts. Coaches emphasised that they are rarely involved in such negotiations and find it difficult to follow how it influences the athletes they constantly interact with.

> *"But all I remember is the lack of support, maybe it was, I want to say greediness but that's not quite the word, the lack of empathy for anything other than the men's game, initially by the male players until they got a little bit of a shove. And then suddenly the women's game and grassroots cricket was pushed as part of the package of why the MOU should go through." [CricketICP1]*

> *'I'll preface this by saying I don't know enough about the MOU because coaches don't get a say and players don't often acknowledge coaches. So that's a difficult one to comment on fully. It's frustrating when players get to talk about all their rights and I sit there and think, wow coaches have just been left behind." [CricketDC2]*

It appears that in the Australian cricket context, the major impact of the recent MOU was recognition of female athletes by adding their voices to the discussion, and subsequent wage growth under newly negotiated contracts. Without the support of decision makers such as board members, this progress may not have happened, but conversely it could have also happened sooner. The advancement of women's cricket was on the agenda of the national sporting organisation for five years before the inclusion of female cricketers, but it can be argued that this was done to "*get things right the first time*". It may also be that a moral connection was needed before changemakers decided to act. One administrator spoke about the moral reasons for advancing the women's game in cricket, speaking about their daughter's experiences and how they hoped the career path to cricket would be a viable and well paved one. However, not all sports can wait until board members have daughters to influence change.

"But for a moral reason, I've got a daughter and I want her to have every opportunity to play cricket just as my sons do so to me it was a pretty easy debate, let's get on with it." [CricketDA1]

Another administrator highlighted that in football, the game is often governed by "*an old-boys network (which) pays lip service to the women's game*" [CricketICP3], highlighting how investment in women's sport can sometimes be superficial to appear "*in line with everyone else (in society)*" [CricketICP3]. This sentiment was shared by an administrator in AFLW, emphasising that the lack of diversity in leadership positions perpetuates a culture in sport which suits the (predominantly male) demographic it is governed by. While programs and academies to help female athletes are well-intended, they do little to empower those women, making it difficult to shape the sport in a suitable way. A lack of recognition for the personal and professional needs of female cricketers has also been reported by Hickey et al. (2016).

"I think leadership, the very top is not very diverse at all and so, you know, women are beginning to be included though I would ask the question how valued they feel their voices are." [AFLDA1]

"It's a real old boys club at the organisation, and I say that from an [insider perspective], I'm working for them a little bit at the moment and it's an old-boys network." [CricketICP3]

In reality, a collective bargaining agreement (CBA) is what holds the contractual power between contracted players and their organisations, coming as a result of extensive negotiations on wages, contact hours and terms of employment. For female basketballers in Australia's WNBL, a commitment to building a pathway for players and maintaining the health of athletes were cemented in the first CBA between players, clubs and Basketball Australia. With a rich history as an elite women's competition, players now have access to a standardised wage, better health care standards, embedded player education and other basic conditions (travel, apparel) that were not available before (Basketball Australia, 2020). While this scenario highlights how far back some female athletes start in their own sport, even after 41 years of a national basketball competition, it also demonstrates a societal shift that sporting organisations are now feeling. If sporting organisations want professional athletes playing their sport, then they need to recognise and promote the professional behaviours of their players and remunerate them accordingly.

4.4.3.2 *Alternative remuneration and revenue*

In the absence of monetary remuneration, organisations are instead expected to provide female athletes with access to resources, facilities, high-quality staff and support structures. Without these alternative means of remuneration, it is difficult to see how players can prepare to perform at the elite level. These organisational elements should be provided regardless of whether professional performance standards are expected, but especially if players are contracted to the sporting organisation. If sports are not yet in a position to financially remunerate their female athletes, then provision of all necessary resources for physical, skill and mental preparation should be prioritised.

> *"Before you pay them, make sure you provide them with adequate medical assistance because they're playing a contact sport. And that wasn't happening (in the AFLW)." [CricketICP1]*

Not all sports may be in a position to pay a full salary to female athletes instantly, but it begs the question why athletes in other contexts are highly paid. Revenue, viewership and broadcasting deals are the business elements of sport which bring in money, but not necessarily make money as there is a difference between profit and revenue (Abrams, 2019). This dichotomy can blur the line between an athlete being treated holistically as a person or as a commodity to sell. "*Putting on a good show*" was tied to the ongoing performances of national female cricketers as though their professionalism is closely linked to viewership.

> *"I think there's always been a performance expectation to win and to win well and to generate interesting content." [CricketDA2]*

> *"I think that if I was to summarise (what professionalism is), doing what you say you're going to do and being accountable, managing your people first before treating them as assets or looking at their output, and being realistic around your financial model." [SportDA1]*

In the context of Australian cricket, developing one of the best domestic competitions in the cricketing world may have been less about developing or promoting skilled cricketers, and more about giving viewers a version of cricket that's easy to consume. The value of the WBBL in terms of broadcasting and fan engagement was a major consideration for why the emphasis on short format cricket is growing, making it easier for people to access and watch. One administrator highlighted that with a global population where ~50% are women, they are an

untapped audience so professionalising female cricket provides access to a greater market. With consistent underrepresentation on television and in the media for female athletes, it appears that until they are valued by broadcasters as a show worth public viewing, it is difficult for the sport to generate the revenue they rely on to pay players.

> *"Realistically females make up 50% of the population, why wouldn't you want to be targeting them from a commercial perspective." [CricketDA1]*

Even when revenue generation is stronger than their male counterparts, elite female athletes may still not be recognised as professional. The case of the US Women's National (football) team highlights that earning more revenue doesn't equal professional treatment by an organisation, with a lack of control over where and when games are played, medical treatment and coaching, as well as how they train and travel (Gajanan, 2019). It is evident that alternative financial resources are required to continue the rise of professionalism in sports, but sports also need to demonstrate their investment into female athletes by creating a financial foundation before generating revenue.

4.4.3.3 *Viable, sustainable and/or liveable career path*

Balancing work and a sporting career were often necessary for players to live in the past, but as cricket grows to become a profession, monetary remuneration needs to reflect the potential earning capacity of that person in any other relatable profession. When asked if cricket appears to be a sustainable and viable career path for female athletes now (Q12), responses were mixed. Some participants reflected on how far the sport has come, detailing the transition from playing domestic or international cricket as a serious hobby to now being able to earn a wage. Others highlighted that this wage is part-time at best, and the maintenance of two domestic contracts is needed before the monetary wage can be considered liveable.

> *"It's better than it was but I would argue it is not enough to sustain life." [CricketDAP1]*

> *"I think if you're good enough to make the international level definitely, domestically there's still a bit of a way to go because if you're not getting a WBBL deal, it can still become a bit difficult to be a full-time athlete on one contract." [CricketDAP3]*

Some participants did not wish for more than their current opportunities to pursue their dreams of becoming a professional athlete, but conceded that there is still room for improvement. While it is undeniable that the sport has changed significantly as a result of placing cricket for women on the national sporting agenda, and updating the MOU accordingly, all cohorts believed there is room for improvement. According to coaches and past players, reaching a stage of professionalism where playing cricket domestically provides players with enough remuneration to live sustainably should be the focus of the next phase. This requires an investment in talent development, which extends beyond the elite echelons and is not reliant on athletes travelling to centralised state and/or national sporting organisations. To develop state/county cricket to the point where it becomes self-sustainable and capable of developing quality elite athletes, investment in female athletes and women's cricket should be felt by local cricket clubs and volunteer coaches of girls teams.

> *"We're not there yet. We're not at the point where state cricket are able to just receive that state income and not concern themselves at all with work outside of cricket so it's a part time wage at best." [CricketDCP1]*

From an international perspective, cricket for females in Australia is considered to be the 'gold standard' pathway to professionalism. Other cricketing nations are said to look to the Australian system for inspiration, with a recent restructure of the talent development programs and domestic competitions in England created to reflect the pathway in Australia. The opportunity to pursue cricket in such a holistic and supported capacity was absent from other international cricket contexts including England, with past players detailing a regional restructuring to provide stronger competition for female cricketers.

> *"I think [Australia have] got the best domestic structure in the world. I think what you do very well out there is you do prepare players to play international cricket through your state cricket setup. We've had to change know the whole history of women's cricket in England to this new structure, which has been quite a challenge." [CricketICP3]*

For nations developing a cricket identity or building their female athlete programs like Ireland, Scotland, the Netherlands and USA, representatives believed there was a long way to go before players can achieve professionalism. In Netherlands and Scotland, the lack of profile for cricket in the nations meant the gendered connotation of the sport being male dominated did not exist, allowing more females to freely enjoy playing the game.

"It was a known sport, but it wasn't a gendered sport, it was just a sport for anyone who wanted to play and in somewhere like Holland, it was one of those weird English sports that some people play. But being a female really probably didn't disadvantage me in those countries purely because they didn't know that girls weren't supposed to play, that perception."
[CricketICP1]

With cricketing nations like England and Australia recently investing $20 – 30 million dollars into their grassroots and women's programs, it is difficult for developing cricketing nations to keep up financially and develop high-performing cricketers (Australian Cricketers' Association, 2020). This issue creates a conundrum: if players cannot dedicate themselves 100% to their pursuit of playing cricket, or that commitment is made in the absence of quality coaching, support staff and quality facilities, then it is very difficult to develop professionally performing players. This theme highlights that professionally performing female athletes are forged by providing all necessary resources to prepare to perform, especially in the absence of financial remuneration which is the next necessary step towards professionalism.

4.4.4 Category 3. The challenges and opportunities of professionalism in women's sport.

4.4.4.1 *Disproportionate effects on and treatment of women's sport*

The interview protocol for this study was inadvertently conducted during the global pandemic of 2020, which contextualised the responses of some cohorts. The worldwide disruption of sport and financial turmoil experienced by many sporting organisations in this year were cause for despair that the progression of female athletes in their sports would falter. These concerns were complemented by a growing call for women's sport to return first, to fill the televisions of people in lockdown around the world. Some participants believed this may have a profound impact on the way women's sport is perceived and valued; rather than competing with men's sport for attention, it can be enjoyed for the display of expert performance that it truly is.

One past player believed that women's sport represents a parallel version of history, where progress can be compared to past events in men's sport. In cricket, the rise of professionalism for male athletes was seen during the World Series Cricket between 1977-1979 in a similar capacity, for a broadcast deal on a network owned by the organiser (Bull, 2017). If this is the case, the advanced standing in viewers may only exist because men's sport was the first to be televised in this context. A return to sport for women first after the effects of the global

pandemic may have had a similar effect, but unfortunately, the aftermath has occurred in direct contrast.

In terms of sports coverage, even while no sports were being played and airwaves were dominated by historical match replays and 'best-of' lists, women appeared to be sidelined. Coverage for women's sport is weak at the best of times, and often only breaches the wave of male-dominated sports journalism when there are notable events like the ICC Women's T20 World Cup, which received nearly a third (32%) of the coverage in that week before dropping back to 12% the following week (Breitbarth et al., 2020; Sport Innovation Research Group, 2020). Cost-cutting measures to alleviate the financial strain on sporting organisations have also centred on their most recent additions: their female athlete programs. In some circumstances, the reduction of staff was maintained by removing the coaches in programs like the AFLW, instead delegating the role of developing female athletes to existing coaching staff involved in the (men's) AFL programs (Zita, 2020).

Other participants representing cricket and Super Rugby W were concerned that the progression for women in their sport would stall as the world paused to recover. After a decades-long charge towards change, which ultimately began in tennis in the 1970s and culminated in 87,000 spectators and 1.2 million viewers for the Women's T20 World Cup final in 2020 (Lemon, 2020), participants highlighted that now is not the time to become complacent or stagnant.

> *"I think we were moving in the right direction. It was slow and things were starting, gears were starting to shift but I think now with what's happening at the moment, no. I think the industry is just going to close ranks and try and pull through and I don't think they're going to think outside the box which I think is a mistake because now is the time to do that and actually bring in different voices. I think survival relies on doing things differently now but I don't think that will happen." [AFLDA1]*

> *"So I think that we haven't fixed anything, people still say to me in my capacity that isn't this all okay now because we've got the AFLW, but they only play for eight rounds and they get no money." [SportDA1]*

4.4.4.1.1 Women's sport as an opportunity

After difficult pandemic lockdowns and social isolation across the globe, the world is yearning for inspiration. This may be an opportunity for sporting organisations representing women in

sport to be proactive and engage new participants, viewers and supporters. To truly harness this opportunity, investment into women and their sports needs to come at a higher cost than saving face when men's teams fail to perform, or using photogenic players for promotion. A superficial investment into women's sport has been highlighted by the global pandemic but it also allows for new paths to be forged, beginning with visibility.

Greater access to viewing and following women's sport needs to be prioritised. After ongoing criticism regarding the coverage of women's sport despite significant funding, each individual should be able to access women's sport simply by turning on the television, as they do with men's sport. This is a large commitment to the accurate representation of the athleticism and expertise of female athletes. One participant outlined that poor quality of livestream services for some sports like the W-League perpetuate the lack of viewership. Watching any sporting match through a lagging camera in the rafters of an empty stadium, and a constant on-screen reminder to swap to the men's match on a different channel would make terrible viewing in any circumstance. While empty stadiums are becoming the norm through a pandemic, the emotional connection that fans feel to a sporting team has not faltered and women's sporting teams like the Australian Women's Cricket Team and the Matildas (football) as exemplars (True North Research, 2020). Understandably, it would be difficult to feel connected to a team when you can't watch their matches with clear quality, or even purchase their merchandise in your size (Hislop, 2020).

> *"Like I remember when the Big Bash, Women's Big Bash first started using the same number of cameras as the men. And the difference was really noticeable. And it's like you watch a W-League game and you've got a single camera in the stadium somewhere on the stream and it's [terrible], but the game's not that bad." [SportDA2]*

There are individual and economic benefits of investing in women's sport too, as detailed in a recent report by The Young Foundation for the Women in Sport charity in the United Kingdom (Women in Sport Organisation, 2019). Individually, providing women and girls access to sports can benefit academic achievement, inspire lifelong learning by engaging with culture and play, promote productivity as well as improve mental and physical health. The professionalisation of women's sport enables the involvement of more women in recreational sport, as investment in programs and facilities improve. The increased presence of more female athletes in mainstream media may also have the capacity to inspire more females to engage in sport and

physical activity, in turn improving the long-term health outcomes of women and girls. Economically, the implications of sporting women and girls with better health can take a significant load off healthcare services, mental health providers, and combat the rise of obesity levels which uses 6.2% GDP in the UK. When estimated across Europe, EUR 16.1 billion could be saved by helping one person in every five reach the recommended levels of daily activity, which sport has the power to do.

4.5 Conclusion

Professionalism in sport may have initially emerged as the antonym to amateurism, but the implications of changing professionalism for female athletes is multifactorial. It is apparent that athletes can, and are expected to, behave professionally in the absence of remuneration, but can only be classified as professional athletes when payment for their services is received. This payment as financial remuneration for their professional preparation to perform is therefore the defining factor of professionalism for female athletes, where their pursuit of sport can become a full-time profession similar to other career opportunities beyond sport. The benchmark of professionalism for the cohorts in this study is defined by domestic athletes receiving adequate financial remuneration to pursue a career in sport despite not representing their nation, as their male athlete counterparts can enjoy.

Investment in female athletes should come from state or national sporting organisations and professional sporting teams in the form of financial remuneration. If not yet financially viable, remuneration should also come in the form of access to all possible necessary resources such as facilities, support structures and high-quality staff. An increase in professionalism has come from a greater societal pressure to achieve gender equality which also brings greater expectations, pressure and scrutiny on female athletes. Organisations should be prepared to support their athletes through these changes as well as finding financially viable ways to build their investment through broadcast deals, sustainable merchandise and promotion. Women's sport provides an untapped opportunity to inspire more diverse audiences to invest in sport and movement, with significant health and economic benefits.

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4.7 Tables

Table 3. Semi-structured interview question guide presented to all participants, which evolved through interactions with initial sample.

Q1	What was your first interaction with your sport? How many years' experience in it/current working area?
Q2	In relation to your sport, how would you define professionalism at the elite level?
Q3	Are there specific values or attitudes that are attached to this level of professionalism? If so, what would you consider them to be?
Q4	How/have these attitudes and values changed over the past five years?
Q5	Is there a greater performance expectation on players now compared to five or ten years ago? If so, how and/or why?
Q6	Does the greater performance expectation extend to coaching staff and organisations? If so, in what ways?
Q7	Has an emphasis on shorter/faster formats been placed on the sport? If so, why?
Q7.1	Has this changed the game in order to be more entertaining? If so, why?
Q8	Is growing professionalism in your sport increasing the skill divide between amateur, state and national athletes? If so, what does this look like?
Q9	What support systems exist for players entering and exiting the professional level of your sport?
Q10	Are these support systems being accessed during an athlete's career?
Q10.1	Do you know to what extent in terms of frequency, depth and recurrence? If so, how often?
Q11	Does your sporting organisation have a memorandum of understanding (MOU) and what does this mean for professionalism in the sport?
Q12	Is your sport a sustainable, viable career path for female athletes now? If so, how and/or why?
Q13	Can the current payment structure for elite athletes in your sport be considered liveable? If so, how and/or why?

Table 4. Hierarchy Chart for Emergent Themes of Professionalism.

Dimension	*Sub-theme 1*	*Sub-themes 2*
Defining professionalism	Paid remuneration	Default definition*; overstated importance*; combination of factors
Athletes behaving professionally	Attitudes and values	Always doing their best*; overcome lack of remuneration; professional behaviours (determination, resilience)*; recognised in policy
	Sport as a profession	Advancing from semi-professional*; commitment and training*; flexibility and work
	Societal pressure	Role models and presence*; tokenism and inclusion; stigma and recognition*
Organisations turning athletes into professionals	Recognise female athletes	Memorandum of understanding; diversity in leadership*; growing feminism
	Alternative remuneration and revenue	Access to resources and facilities*; high quality staff and support structures*; viewership and fan engagement*; revenue generation
	Viable, liveable career	Part-time wage*; opportunity to pursue dreams; room for improvement*; Australia as 'gold standard'
Challenges and opportunities	Challenges	Effects on women's sport during crisis; treatment of women's sport
	Opportunities	Inspiration*, emotional connection*

Note: Asterisk (*) denotes topics which reached conceptual saturation prior to recruitment of sample of participants from sports other than cricket.

Declaration of Co-Authorship for Chapter 5

In the case of Chapter 5, the nature and extent of my contribution to the work was the following:

Nature of Contribution	Extent of Contributions (%)
Conception and design, acquisition and analysis of data, drafting and revising, final approval of version to be published, agreement to be accountable.	80%

The following co-authors contributed to the work:

Name	Nature of Contribution	Contributor is also a UC student (Yes/No)
Naroa Etxebarria	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
David Pyne	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff
Wayne Spratford	Design, data interpretation and reliability, revising work, final approval of version, agreement to be accountable.	No - Contributor is UC Staff

Candidate's Signature

Date 10/02/2021

The undersigned hereby certify that:

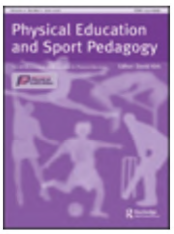
(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Location(s):	University of Canberra, Faculty of Health

Signatures	Date
Naroa Etxebarria Perez de Nanclares	10/2/2021
David Pyne	11/2/2021
	10/2/2021

Chapter 5 Task design for amateur cricketers



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Evaluating task design for skill development in an amateur female cricket team

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5.1 Abstract

Motor control and skill acquisition research have contributed greatly to understanding the learning process in sport, but very little of this knowledge has been applied in practice over the past fifty years. The characteristics of expertise in the two major cricket skills, batting and bowling, are well established but the training environments used to develop them are yet to be characterised. Recommendations on the how the ball is delivered (feed), decision making, task variability and information sources for skill development in cricket have been made previously in research. To promote skills which transfer between the training and performance environments, tasks should maintain the connection between the person, their task and the environment. Coaches have found it difficult to apply complex learning designs to their practice because the underpinning concepts remain unclear. Demystifying evidence-based practice for skill development in cricket is needed to make research knowledge more accessible for coaches. Purpose: Given club level cricket (amateur) is the stepping-stone of the talent development pathway for junior representative players pursuing elite status, it is important to evaluate the effectiveness of skill development practices at this level and identify means of improvement.

A categorical assessment tool was developed to assess 21 training sessions performed during an amateur women's cricket team throughout the 2018/19 season. We assessed how the ball was delivered (feed), decision making elements, variability and sources of information available to ascertain the representativeness of each training session according to published research on skill development and expertise. The tool featured a scoring range (0–3) with maximum scores per discipline of 12 for bowling and 15 for batting. Key performance indicators (KPI), outlined by the head coach, were also collected during the season to assess game performance and explore any connections with training design. A lack of variability in training design between the 21 sessions performed (<0.5 units on 0–3 scale) did not allow for a correlational analysis with game performance. In contrast, game KPIs were achieved sporadically throughout the season. The most representative training elements were provided for bowling feed (target), decision making and variability, while batting feed (type) and variability also scored well on the assessment tool. The maximum score for representativeness for bowling or batting was not reached, and training design remained largely unchanged throughout the season despite changes in match type, competition phase and consistent low

scores in some elements. Some elements of representative learning design were apparent in this amateur cricket setting but only in discrete areas of training. Despite changes in the competition phase and match type, there was a lack of adaptation in training design. Future research is needed to evaluate the principles of representative training design and their effect on cricket skill development and match performance. A more sensitive categorical assessment tool may also be necessary to detect subtle changes in training design.

5.2 Introduction

Nonlinear approaches to skill acquisition are a rapidly growing area of research but its application to practice in specific sports has only recently begun to appear (Chow, 2013). The underlying tenets of nonlinear pedagogy challenge the traditional notions that information must be processed before it can be acted upon and that an optimal movement pattern exists to solve game-specific problems (Davids et al., 2013). The understanding of how perception occurs while humans interact with their environment suggests that visual information is readily available and informs our actions through couplings, where what we see and how we move are inextricably linked (Le Runigo et al., 2005; Warren, 2006). This has major implications for the way learning occurs in training environments, with design principles that highlight the importance of providing the same sources of information when playing the game and training for it (Portus & Farrow, 2011; Yiannaki et al., 2018). Prescriptive technical movements are also being reshaped to feature a more exploratory approach to skill acquisition, which recognises that the action capabilities of each individual are unique on a cognitive, affective, and behavioural levels (Glazier et al., 2005; Renshaw et al., 2009). These differences also account for how expert performance in the sporting world is characterised by the ability to apply variability in a functional way (Phillips et al., 2012) rather than recreating the exact same movement pattern over again. The training environment should endeavour to achieve action fidelity, where the actions that emerge in the performance environment also arise at training (Pinder et al., 2011b).

Learning design principles are based on the connection between the performer and the environment, which was originally proposed by Brunswik (1955) in an experimental context that has since been linked to sports performance. To understand a behaviour, the environment must provide the same affordances or opportunities to move that they would normally experience during performance (Renshaw et al., 2010). For example, cricket features a contest

between a live bowler, two live batters (one facing the bowler), an open field guarded by the bowler's teammates and a range of contextual information about the state of the game. The training environment does not need to perfectly recreate the performance environment; instead, it should represent similar situations and challenges that a performer would face in a game environment (Brunswik, 1956, p. 39). According to the concept of probabilistic functionalism, organisms select the information sources which are most useful for responding from the environment, making the perceptions of the environment probabilistic rather than certain. As such, this would be best achieved by providing the same sources of information in the environment, task and person(s) so the performer has the opportunity to interact with them (Brunswik, 1955a). Representative learning design (RLD), therefore, requires coaches to factor in all of the factors (named constraints) that influence behaviour and the outcomes of manipulating them. Even small changes such as facing a bowling machine instead of a live bowler (Pinder et al., 2011), or verbalising a movement instead of performing it (Dicks et al., 2010) can produce vast differences in perception and action (Pinder et al., 2011b). When coaches have applied nonlinear approaches in the past, they have found it difficult to understand the concept well enough to create the learning environment (Roberts, 2011), or have misconceptualised what the approach looks like in practice (Partington & Cushion, 2013).

Resources that aid the application of RLD are beginning to emerge, with textbooks based on the constraints-led approach for sports coaching (Renshaw et al, 2019) and practical studies in tennis, AFL, and cricket. Identifying the existing constraints within a sport can be difficult, so Renshaw et al. (2019, p. 24) provide a template with a colour-scale representativeness dial to help coaches understand the behavioural benefits and affective costs associated with how much variability is designed into a session. A thorough understanding of constraints-based theory is still required to move from session design to specific task design though, which is where the gap in understanding has been identified in the past (Ford et al., 2010). Woods and colleagues (2019) proposed three ways to visualise, analyse and measure representativeness in AFL tasks but this also requires a thorough understanding of performance data and modelling techniques. The constraint comparison matrix featured as Figure 4 (Woods et al., 2019, p. 324) appears more intuitive by classifying tasks and assigning a representative value, but this still requires extensive data from the training and playing environment that coaches may not engage with. In tennis, Krause and colleagues (2018) operationalised RLD for coaches by creating a validated practice assessment tool with questions that embody the

key concepts of goals, constraints, variability, perception-action coupling and decision making. The generalisability of some questions allows for the tool to be utilised in other sports and as another interception-based sport, cricket was suggested as a future direction by the authors. Using the same underlying principles, a categorical approach to training design was made in this study to provide coaches with a tool that helps shape their task.

Constraint Class	Constraint	Description	Sub-Category Label
Task	Possession time in general play	Time between a player obtaining and then disposing of the ball while in general play (i.e., not from a mark or free kick)	0–1 s 1–2 s 2–3 s >3 s
	Possession time from a stoppage in play (i.e., a "mark")	Time between a player obtaining the ball from a stoppage in play (mark or free kick) and then disposing of it	0–1 s 1–2 s 2–3 s >3 s
	Disposal location	Location of each ball disposal (kick or handball) partitioned into four field locations	Defensive 50 Defensive Midfield Attacking Midfield Forward 50
Environmental	Target density	Number of opposition players within a 3 m radius of the intended disposal target	Uncontested (e.g., 1 vs. 0) Even (e.g., 1 vs. 1) Superior (e.g., 2 vs. 1) Inferior (e.g., 1 vs. 2)
	Ball carrier density	Number of opposition players within a 3 m radius of the ball carrier at ball disposal	<1 Opposition Player 1 Opposition Player 2 Opposition Players 3 Opposition Players >3 Opposition Players
Individual	Disposal movement	Locomotive state at point of ball disposal	Stationary (e.g., walking) Dynamic (e.g., running)

Note: "s" denotes seconds, "m" denotes metres.

Figure 4. The constraint comparison matrix used in Woods et al., (2019).

5.2.1 A Categorical Assessment Tool – Task Design

Renshaw and colleagues (2019) propelled the application of constraints-based approaches to sports coaching by providing a guided handbook which outlines the key principles of practice design and philosophy. A categorical assessment tool was developed to characterise the key principles of practice design in cricket based on the critical theoretical and practical knowledge available in the field of skill acquisition. This tool was inspired by Muller and Abernethy (2008) and developed by the primary researcher. Each component featured in the tool in Table 5 is underlined by a theoretical concept which contributes to representative learning design, and the aim of the tool is to allow observes to assess the level of representativeness of a task based on these components. The characteristics of the tool were categorised in four ways: the

"feed" component, which refers to how the ball is delivered towards the batter and by the bowler; the "decision making" component which refers to the sources of information that aid in decision making such as knowing whether bat-ball contact results in a run, wicket, dot ball or boundary; the "variability" component, relating to how variability is incorporated in a task, either within the task through challenges and game-related scenarios or through the use of multiple tasks, each differing in some way, and; the "information sources" component, which characterises some of the most common sources of information that athletes are likely to utilise during match play to inform their actions. As three components emerged for two categories, the scoring system for the tool was determined as scores out of three (3) for each section, with a maximum of 12 points for batting tasks and 15 points for bowling tasks which features two feed components. As such, if a component of the decision making or information sources is missing, only the present components are scored while the feed and variability components are explicitly detailed within the tool. The development of the tool is supported by the following theoretical concepts and practical knowledge available in existing skill acquisition research.

Within the handbook by Renshaw and colleagues (2019), a simplistic approach to improving the representativeness of a task in skill-based sports training can be found in Figure 5, highlighting traditional practices and how they can be modified for three sports (Renshaw et al., 2019, p. 24).

Figure 5. Examples of traditional and alternative RLD-enhanced practice design, Table 2.1 in Renshaw and colleagues (2019, p. 24).

In the cricket example, the recommendation to replace the bowling machine with a live bowler and game

Task goal	*Traditional method*	*Alternative RLD-enhanced practice design*
Mountain climbing	Indoor climbing wall	Real mountain
Dribbling in team games	Dribbling around cones	Dribbling in a directional practice around an area with other players moving and dribbling
Swimming practice	Swimming circles with other swimmers in a lane	Swimming against others in different lanes. Use of handicapping to experience swimming when leading or trailing
Batting against a spin bowler	Facing the Merlin bowling machine in a net	Facing real spin bowlers in simulated game scenarios
Practising athletic run-ups	Run-throughs (no jump)	Running up to jump in a simulated competition
In play basketball shooting	Unopposed, repetitive, static shooting	Dynamic shooting with the presence of defenders

scenario is based on the important cues that expert batters use to anticipate how the ball will come towards them (Morris-Binelli, 2016). Visual anticipation by experts is often sourced from the movements of the bowler (Müller et al., 2009), and when facing a machine, crucial functional behaviours (front foot movement and backswing initiation) are delayed (Pinder et

al., 2009). How the batter moves also informs the bowler's next action alongside the line and length of their previous deliveries (Phillips et al., 2012). The coupling between what the batters were seeing and how they were moving did not represent the game-specific problem they were facing in performance, so the desired behaviour failed to emerge. The “feed” component in this tool refers to the way the ball is delivered to the batter, with an emphasis on maintaining match-like interactions between live bowlers and batters.

Decision making skills in sport are crucial to performance, with investigations into the development of tactical skills highlighting that training requires more than repetitive practice (Araújo et al., 2019; Low et al., 2013). The exploration of multiple strategies as they emerge in the game is believed to be more conducive for tactical skills (O’Connor, Larkin, & Williams, 2017), calling for the inclusion of games-based sessions for skills training while struggling to provide coaches with the knowledge to apply them (Price et al., 2019). The constraints-led approach to coaching is underpinned by the connection between the performer and the environment. The manipulation of constraints, such as the size of the field, number of opposition players, or size of the ball/bat, can influence the behaviours that emerge during the performer’s interaction with the training environment (Renshaw et al., 2019). Small-sided games, when designed with appropriate constraints, can provide the opportunity to develop strategic thinking and skill acquisition in an environment which may look and feel like the game (Pill, 2012). This leaves little room for explicit instructions, isolated drills, non-pressured environments and coach interruption (Orth et al., 2017), and allows performers to establish the likelihood of success from their actions, namely probabilistic expectation (Williams et al., 2011).

While bat-ball contact is important, judging the opportunity to run emerges from the gaps between fielders, similar to passing channels in football (Uehara et al., 2018). The presence of fielders can elicit changes in behaviour, encouraging batters to avoid the fielders and score runs while bowlers target those fielders for a dot ball or wicket (Gorman & Maloney, 2016). Through the connection between perception and action, bowlers also yield decision making information from bat-ball contact, consequence and their own execution of line and length (Phillips et al., 2012), shaping the affordances of the batters in return. The physical demand of training has been explored in a male population before (Vickery et al., 2018) and constraints-based approaches now also feature as interventions (Connor et al., 2016) but little is known

about training design for senior competitions in the amateur female context. Understanding the training design for development in amateur cricket (including junior, emerging and senior players) is crucial to providing ongoing access to talent development beyond the pathway (Martindale et al., 2007).

The role of variability in the training environment has also changed as learning conceptions continue to develop (Chua et al., 2019). Another underlying concept from the constraints-led approach is the notion of 'repetition without repetition', where a task can be practiced repeatedly but not identically (Bernstein, 1967; Stambaugh, 2010). Traditionally, a linear pedagogy was applied to skill acquisition where the components of a task were learnt in isolation and re-integrated, based on the assumption that each sub-task must be independently mastered before putting the movement back together again (Dicks, Davids & Araújo, 2008). In a dynamic sport such as cricket, movements are instead highly interdependent (Turvey, 1990), not just in one individual but also between the two competing roles of batting and bowling. Including a combination of different tasks (between-task variability) and different activities within the same task (within-task variability) allows for the interruption of identical repetitions but maintains the need to solve ongoing task-related problems (Coughlan et al., 2014). This variability should be tailored to the learning stages and provide multiple tasks that feature a limited to high variability, as higher levels of variability may create low levels of perceived competence and may appear uncontrolled and overwhelming (Renshaw et al., 2019, p. 140).

The sources of information that athletes use to inform their opportunities to act (affordances) appear in a visual field which performers become more attuned to with exposure and experience (Fajen, Riley, & Turvey, 2009; Jacobs & Michaels, 2007). While the importance of maintaining the presence of this information has been emphasised for batters and bowlers already, there are other sources of information that influence action in cricket aside the bowler's kinematics such as the 9 fielders. Along with the gaps they provide to score runs (Orth et al., 2014), teammates play a crucial role as a batting partner with a unique skill set, or as a bowling partner to build pressure with and create wicket-taking opportunities. The perception of shared affordances between teammates allows for team coordination, such as knowing when to run between wickets or which fielders the ball might be coming to based on the bowler's game plan. This 'knowledge of' the environment happens in real-time and is

developed as players become attuned to where the key sources of information can be obtained, including the movements and execution of the batter or the bowler (Silva et al. 2013).

Contextual information about the performance environment also shapes behaviour, with the absence of score status (i.e., required run rate), match importance (i.e., round game or final), momentum (repeated attacking play) and personal performance all playing a role in other sporting contexts as well (Levi & Jackson, 2018; Maloney et al., 2018). While limited resources may mean that an open field and additional fielders are restricted, the sampling of this information should aim to recreate match situations as closely as possible, allowing the same cognitions, emotions and actions to emerge (Headrick et al, 2015; Maloney et al., 2018). The use of scenarios and games could maintain action fidelity by promoting the actions and decisions that would emerge in the performance environment (Pinder et al., 2011b).

5.2.2 The Present Study

Coaching practice assessment tools have been available for some time, but the need to support coaches in applying the concepts of constraints-led coaching and RLD to their task design remains. The categorical assessment tool designed in this study aims to provide a framework for coaches to build their session designs on while also reviewing the representativeness of the session. This may allow coaches to inform their practice and promote development. The purpose of this study, therefore, was to assess the application of the training design tool on amateur female cricketers over an entire competitive season (25 weeks). The primary research questions were to evaluate whether task design throughout the season aligned with RLD in this cohort, and if training influences game performance.

5.3 Methodology

5.3.1 Experimental Approach

A single group prospective observational design was employed to capture the application of task design characteristics in a cohort of amateur female cricketers. All available training sessions were systematically observed and coded by the principal researcher throughout the 2018/19 season of Premier Grade Cricket (Brisbane, Queensland, Australia). Observational data on the training task design prescribed by the Head Coach for skill development were collected. Task design elements for feed, decision-making, variability and information were

sourced from skill acquisition literature in cricket and the conceptual framework behind constraints-led approaches to learning (Table 5). Game performances was determined by achievement of key performance indicators (KPIs), which were skill-based goals for increasing individual and team performances identified by the Head Coach. The evidence presented in this paper highlights the alignment of a representative set of training practices with RLD at the amateur level for female cricketers. In accordance with the skill acquisition literature and constraints-led approaches to coaching, four domains were included in the categorical assessment tool (feed, decision making, variability and information) to establish where skill development practices can be improved.

5.3.2 Participants

Twelve amateur female cricketers (age 22.3 ± 8.7 years; 54 ± 42 matches played: 5 ± 3 years with the club; mean ± SD) competing in the Queensland Premier Grade Cricket competitions were observed for the duration of the six-month season (21 training sessions; 17 games). The coaching staff remained blinded to the content of the observational measures to avoid influencing session design. Participants were invited to participate in the study through a letter of invitation detailing the context and expected involvement and regular attendance at training. The study was approved by the Human Ethics Committee of the University of Canberra and participants provided written informed consent prior to the commencement of training for the season after being presented with the purpose, benefits and risks of the study in writing (approval number 20180352).

5.4 Data Collection

5.4.1 Training Task Design

Task design elements were measured for all unique tasks completed during each training session to determine the representativeness of every task. Training sessions consisted of fielding practice on an open field (~30 min duration), followed by batting and bowling in a netted environment (~60 min duration). Over the 25 weeks of the season, a total of 21 training sessions were performed, observed and analysed.

Task design elements for feed, decision making, variability and information were observed for batting and bowling skills using a 4-point categorical assessment tool. The tool

was developed to code the relevant empirical evidence on representative learning design for cricket skill development. Decision making elements and sources of information were grouped into three specific components so tasks most representative of the performance environment could score a maximum of three (3) on the scale, with a total possible score of 12 for batting and 15 for bowling in one training session.

5.4.1.1 *Batting*

The feed related to how the ball was delivered to the batter, ranging from a stationary ball being dropped from shoulder height in front of the batter (0), to underarm throws (1), overarm throwdowns (2) and a live bowler (3) as delivered in a game. Decision making elements included bat-ball contact, the direction of the shot and any consequences afforded (runs, wicket), which were scored depending on how many were present in the training environment (out of 3). Variability was based on the learning task design, where the most conducive application for skill development features a combination of within- and between-task variability (3). Within-task variability (2) provides a greater opportunity to explore movement solutions and adapt to changing circumstances, therefore scoring higher than between-task variability (1) or none (0). Various sources of information present in the performance environment ranging from the action capabilities (skill, speed) of teammates to inform run scoring opportunities, the opponents including the bowler and any surrounding fielders, and the context of the task such as match importance, required run rate, score status or momentum were rated (out of 3).

5.4.1.2 *Bowling*

The feed for a bowler related to how the ball was delivered, using target and pattern to differentiate what the bowlers were aiming for and how they approached. In the performance environment, bowlers delivered six balls (one over) at a time (score of 3) towards a live batter (also 3). The feed pattern was altered if bowling with a partner (2), interrupted by a group (1) or from a shortened approach (0), while the feed target was less representative when a live batter was replaced with targets (2), the stumps alone (1) or nothing (0). Decision making elements for bowling included bat-ball contact and consequence, including line and length information of the ball bowled which inform where a bowler chooses to bowl next (Phillips et al., 2012). These elements were also rated by a score out of three (3) depending on the number

of elements available in the task, with multiple possible combinations. Variability remained the same for bowling where the combination of between- and within-task variability (3) encouraged bowlers to bowl at a variety of batters and practice a variety of lines and lengths. Information sources were also identical for bowling, where bowlers performed in partnerships and relied on the fielding efforts of their teammates, adapted their bowling plans in relation to the opponent's (batter) capabilities, and required contextual information such as required run rate, score status, momentum and match importance. Information was also scored out of three (3) based on the number of sources present, with multiple possible combinations.

5.4.2 Game Performance

5.4.2.1 *Key Performance Indicators*

At the elite level, the margin between winning and losing has been quantified in 50 and also 20 over matches to understand which behaviours contribute to successful match performance. This notion has been adopted by the head coach at the amateur level, identifying skill-based behaviours that are likely to contribute to success during the season. A higher run rate and wicket taking ability are the characteristics of elite KPIs in both formats (Petersen et al., 2008a; Petersen et al., 2008b), so this was replicated in a series of process goals for the team throughout the season. In this study, the coach and playing group determined their KPIs anecdotally prior to the season commencing. With the bat, KPIs featured rotating the strike (singles), building momentum and scoring in partnerships, limiting decision making errors when running (no run outs as “no r/o”) and scoring off each deliver (scoring shot percentage as SS%). With the ball, constraining the opposition’s ability to score (dot balls) and limiting unforced errors (sundries) were the focus. Game data was available for ten 50 over matches and seven 20 over matches.

5.4.3 Statistical Analyses

A single group prospective longitudinal analysis of the training domain to quantify the application representative learning design through feed, decision making, variability and information elements. Mean and SD of a categorial assessment tool (integer ratings of 0-3) were used to analyse the design characteristics of the 21 training sessions. Maximum scores for bowling (15) and batting (12) are presented in Figure 6. For the analysis of 20-over and 50-over key performance indicators, a score out of 4 or 5 per game was determined depending on the skill under examination. Thus, each game had four bowling indicators and five batting

indicators, and each score in Figure 6 displays this per game. These data were also converted to a percentage to indicate the overall pattern of KPI achievement more clearly throughout the season. Ordinal regression models were considered for a correlational analysis between training and game measures. Chi-squared tests of association could also be applied to determine the significance of changes in training measures across the season. However, the marked lack of variance in training design characteristics precluded application of these statistical approaches.

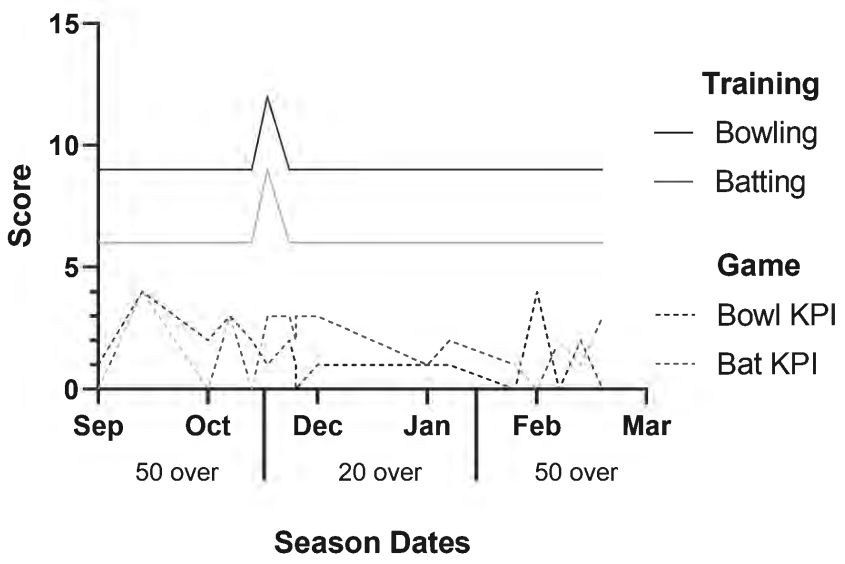

Figure 6. Figure 6. A comparison of training representative task design scores with game key performance indicators in one competitive season for an amateur women's cricket team. Maximum scores for training design features were 12 points for batting and 15 points for bowling per session. Four (4) bowling and five (5) batting key performance indicators were recorded per game.

5.5 Results

5.5.1 Training

Training task design elements were recorded over 21 training sessions with only two elements achieving the most representative score for skill development. A variable pattern of responses was observed across the disciplines of bowling and batting, with means and SDs illustrated in Table 6.

5.5.1.1 *Bowling*

The most representative element of training design included feed target (3/3), with consistent scores in decision making (2/3) and variability (2/3). While feed target received the highest score because bowlers bowled towards live batters, the task designs only provided two sources for decision making (contact, line and length) and utilised only within-task variability (2/3). Feed pattern was interrupted (1/3) and sources of information were limited to opponent only (1/3), registering the lowest scores for training design. Minimal variance was recorded throughout the season, reflected in the small SD of feed pattern and information sources given that only one open field training session was conducted.

5.5.1.2 *Batting*

The most representative element of training included feed type (3/ 3) which featured live bowlers, complemented by consistent within-task variability (2/3) from a variety of bowlers. Other task design elements rarely featured for batting tasks with one decision making source (contact) and the absence of opponent, teammate and contextual sources of information. Minimal variance was evident in decision making and information sources, with the single open access field session providing contact and direction alongside information from opponents and a teammate during the batting task. According to the video analysis, batters participated in a batting task for 10 minutes per session.

5.5.2 **Game**

Key performance indicators established by the Head Coach prior to the commencement of the season were extracted from match statistics at the completion of the season. The overall pattern of achievement is presented as percentages for 50 over matches (Table 7) and 20 over matches (Table 8). Throughout the season, bowling KPIs were achieved more regularly in the 50 over matches, with a maximum achievement level of 75% (3/4) and minimum of 50% (2/4) in individual matches. Batting KPIs were attained less frequently with a maximum of only 40% (2/5) for this game format, which was improved to include more consistent achievement of scoring shot percentages (86%) and an absence of run outs (71%) in the 20 over games. Bowling KPIs in the shorter game format only featured a more regular reduction in extras (86%) and dot balls to begin an over (58%). Figure 6 maps the individual game data, using the number of bowling (out of 4) and batting (out of 5) KPIs achieved per game.

5.6 Discussion

In one of the few season-long reviews of task design for skill development in amateur cricket, training design did not appear to align with RLD in this cohort. Understanding of how training influences game performance was also limited with sporadic achievement of the predetermined KPIs throughout the season, and limited variability between training sessions. Elements of task design such as feed were consistently present during training, but little decision making, and variability was included. Only limited emphasis was placed on the inclusion of information sources for both batting and bowling. The small variance apparent in the task design scores (Figure 6) indicates that the same elements were used to design each task despite changes in match format (50 overs and 20 overs) and competition phase. Only one session approached the maximum representative score over 21 weeks, where access to an open field provided decision making and information elements that are difficult to replicate in the regular enclosed netted environment. Throughout the season, coaches harnessed an identical approach to training design each week. This may limit the transfer of skill between training and the game and create a monotonous learning environment for the players. It is unclear whether this approach to skill development stems from a lack of understanding around training design and constraints-led approaches to coaching, or a lack of investment, time and resources to continue developing this cohort. These outcomes underscore the priority for detailed analysis of the prescription, implementation and evaluation of training programs and coaching behaviours at the amateur level of cricket. More work is needed to identify where improvement in skill development and transfer can be made in practical and research settings.

In the task design employed at training, consistently high scores were observed in selected elements of batting (feed type and variability) and bowling (feed target, decision making and variability) which were complementary. This pattern indicates that activities in these domains adequately sampled or represented the game environment. Bowlers were provided with the opportunity to couple their movements with live batters and make informed decisions based on bat-ball contact and their line and length. This pattern of training may have contributed to the greater consistency in key performance indicators during the season. Batters could locate cues in the approaching live bowlers, but key sources of information and decision-making elements were rarely incorporated in training activities. At the amateur level, it can be

difficult to access an open field to provide the direction and consequence of bat-ball contact, but low scores (0-1) indicate that sampling in the nets could have been optimized.

A strategy to enhance training design includes harnessing visual constraints like markers, pegs or an illustrated whiteboard to represent the presence of surrounding fielders, providing information to sample for deciding if there is a run available after bat-ball contact. The ongoing absence of sampled information may have made it difficult for players to understand the affordances created from certain batting strokes which can be seen in the low achievement of some key performance indicators in the 50-over matches. On the contrary, some batting elements (SS% and No r/o) were much stronger in the 20-over format, which has also been observed in elite male cricketers (Petersen et al., 2008b). This result appears counterintuitive, given the reduced ability to practice running under pressure in the nets with limited decision making and information elements, and added pressure to score runs during the match. The variable pattern of achievement in games indicates that a shift in performance occurred despite a lack of change in the training design to accommodate the difference in match type. The specific constraints and objectives of the T20 format may have contributed to match performance, with an emphasis on scoring runs quickly, taking every opportunity to score runs, and reducing the number of unforced errors such as poor communication resulting in a run out. With a greater investment in these objectives, this may have been enough to influence the behaviours of the athletes on match day. Subsequently, the more aggressive approach to batting in the T20 format makes it increasingly difficult to achieve bowling objectives, resulting in consistently low achievement of bowling KPI's during T20 matches. The ability to control a match with bowling performances, such as executing bowling plans and setting fielding positions to restrict the scoring ability of the batter, is an advanced skillset which was not discussed throughout the season, nor integrated into the training design.

5.6.1 **Bowling**

The presence of live batters (score of 3) while practicing bowling allowed the bowlers to couple their actions with the batter's movements, a connection that is central to the contest in cricket between bat and ball. While including this element in training can help bowlers determine the effectiveness of the current delivery and inform future behaviours (Phillips et al., 2012), access to other decision-making elements such as bat-ball contact and the line and length of the ball were also available during training (2/3). The maintenance of this coupling between perception

and action is integral to the game of cricket (Gibson, 1979), but other key sources of information were absent from the skill development activities. While the batter's movements are informative to a bowler as their opponent (1/3), the absence of any context may have limited the transfer of bowling skills to the highly contextual performance environment (e.g., scores, required run rate, wickets). Bowling effectiveness is often dictated by the capabilities of teammates, in bowling partnerships to create pressure and the fielders' abilities to stop, throw and catch the ball, but these elements are difficult to simulate in an enclosed environment. These sources of information were only harnessed once, during a single training session on an open field and turf pitch which is believed to be the most conducive environment for cricket skill development (Renshaw & Holder, 2010). Access to these resources at the amateur level is limited so emphasis must be placed on the sampling of information for training design in enclosed environments.

Sampling can be incorporated by using markers to simulate fielders in the nets or applying contextual information to an activity through scenarios (e.g., 10 runs off 6 balls). Within-task variability (2/3) was created by changing the live batters that bowlers were exposed to, providing a variety of opponents to compete with. Simultaneously, the bowling feed pattern was interrupted (1/3), opting for one delivery bowled per person to increase time on task for multiple participants rather than bowling in overs (6 ball block per person) as performed in a game. The connection between each ball in an over provides tactical information for both the bowler and batter, based on current skill execution and previous experiences, while also building pressure or changing the momentum of the game depending on runs scored, dot balls or wickets taken. Feed patterns can be improved by bowling in tandem with a partner or providing alternative activities while bowlers complete their over. Overall bowling scores indicate that representative design was evident in a number of elements which can be easily controlled in enclosed environments. However, the inclusion of scenarios for context (e.g., 24 runs off 24 balls), active teammates (other bowlers and batters or fielders), and consequences (runs, wickets) may have provided added value to the training session.

5.6.2 Batting

The presence of live bowlers while practicing batting is also the greatest source of feed type information, which was maintained throughout the season of cricket training. This scenario provides batters with the opportunity to use the bowler's kinematics to inform their batting

behaviour despite the absence of information from a batting partner (teammate), and game context, for the majority of the training sessions. Contact between the bat and ball was the major source of decision making throughout the training session (Connor et al., 2018), with little opportunity to gauge the direction or consequence of particular shots. When a single training session was performed on an open field, this option allowed for the brief understanding of shot direction in relation to the fielders, but without an underlying game context, the availability of shot consequence (runs/wicket) was still limited. The effectiveness of batting performance occurs through the combination of bat-ball contact, direction and consequence - deprivation of these sources of information for decision making makes it difficult for a skill to transfer from a training to a game context, when those factors are crucial to performance.

Within-task variability was maintained throughout the season by exposing the batters to a variety of live bowlers, often adapting to unique bowling styles consecutively as a variety of bowlers performed one ball at a time. When training in a closed netted environment, it can be difficult to simulate the direction and consequence (decision making) as well as opponent context and teammate information. If access to an open field can be arranged, a batter can practice redirecting the ball into space on the field against live bowlers (3/3), or overarm throwing (2/3 sources) to increase time on task. This activity can be maximised to include opponent fielders, contextual information (run rate required), a batting partner (teammate), and the opportunity to run between wickets or be dismissed (consequence). Without open field access, the application of observational judgements for runs scored, scenarios, batting with a teammate and visual targets in the nets are examples of sampling which may promote skill development through RLD (Renshaw & Holder, 2010). Contemporary training practices with amateur female cricketers which do not align with RLD may limit skill development and transfer to game performance.

5.7 Conclusions

The lack of representativeness in the training sessions observed in this study may have limited skill development and transfer through the absence of key information sources, and lack of adaptability to changes in competition formats and demands throughout the season. By providing coaches with a tool which guides training design in four domains (feed, decision making, variability and information), there is potential to improve the application of RLD for skill development at the amateur level of cricket. To establish and validate task design

elements, the transfer of behaviours between training and the game should be captured for direct comparison in a controlled performance environment such as a scenario-based test featuring all game variables. It is possible that the coaching tool lacks the sensitivity to detect changes in task design, but this is difficult to ascertain when the same tasks were employed during this study. Given the tool was designed to determine the alignment of training practices with RLD, different tasks may achieve the same score depending on the learning environment they provide, ultimately informing coaches on their approach to skill development. The use of alternative coaching assessment tools such as the scaled approach in tennis (Krause et al., 2018) or colour scales (Renshaw et al. 2019, p. 155) may be beneficial for future tool development. As the tool currently adapts existing theoretical knowledge into actionable elements of training practice design, further research should be conducted to ensure that the components of task design accurately assess the representativeness of a task and capture the elements which simulate the performance environment beyond whether the task looks "game-like".

A major barrier in skill acquisition research is the inability to capture expertise because it is difficult to create the same match environment during testing (Pinder, Headrick, & Oudejans, 2015). This shortcoming provides researchers with the opportunity to utilise three different environments (training, testing and game) to assess the impact of information poor training environments on skill development and transfer. While an observational study identifies current practice, further evidence of the training characteristics which allow skills to transfer between the training and game environments, such as the value of sampling or access to an open field setting, is needed. This study detailed a longitudinal description of the training environment in female cricket, which lays the foundations to further our knowledge on current practices and explore future interventions that maximise the development of amateur cricketers. A controlled study using two groups of participants with multiple training programs would be ideal but difficult to replicate in an amateur sporting team setting (Connor et al., 2016). It is also important to acknowledge the connection between cognitions, emotions and actions in the performance environment, where the perception of affordances, focus of attention and action capabilities may be compromised by high anxiety (Graydon et al., 2012; Headrick et al., 2015).

5.8 Practical Considerations

Sporting clubs at the amateur level of cricket rarely have access to an open field and turf pitches, which is believed to be the optimal training environment for skill development (Low et al., 2013). Through the application of representative learning design, available resources can be adapted to simulate the performance environment and provide match-like situations and problems during training, rather than attempt to replicate a condensed version of the game (Davids et al., 2013). The presence of fielders and goal-directed behaviour may be maintained through the creative use of equipment (markers or detailed whiteboard) to represent where players may appear in the field and scenarios (24 runs off 24 balls) to overcome the absence of consequences, direction and affordances from bat-ball contact. The interactions between the batter and the bowler should be maintained, allowing for the exploration of visual cues often found in the bowler's approach or the batter's footwork, and different tactical approaches (ball type, shot selection) for a successful outcome (runs, wicket). Open spaces such as a grass field (with or without a cricket pitch) should be utilised when possible to provide access to distance and consequence elements while embracing the inherent variability that comes with the ball bouncing off the grass. Otherwise, coaches can develop novel ways to simulate information sources through experimentation and discussion with the athletes to determine if they can utilise that information, such as placing single plastic stumps within the netting of an enclosed batting environment to simulate where a fielder would be. This exploration of information does not happen intuitively (Jacobs & Michaels, 2007), so training environments should allow learners to identify or draw attention to how an opponent moves or what their game plan might be from the current field setting, as they would in the game environment.

There are resources available for coaches that inform of contemporary skill development practices and strategies (Renshaw & Chow, 2018). The scoring system featured in this study may need to be reviewed to promote individualised approaches for learning stages. To capture the nuances of session design, the integration of a larger scale with guided questions and task goals (Krause et al., 2018) or a colour scheme to tailor the difficulty and structure of the session (Renshaw et al., 2019) should be considered. By providing key elements of the training environment within the tool (i.e., where sources of information arise), amateur coaches may be more likely to apply an evidence-based approach to their training environments. Applying certain instructions ("try to hit the ball past the bowler")", scenarios (10 runs off 6 balls) and tasks (bowling to take a wicket/restrict runs) allows a variety of movements to be

explored and emerge as the person interacts with their environment. This approach encourages the development of skills by utilising the available sources of information within both the training and performance environment, with the potential to improve the transfer of skill. Future research should endeavour to capture the coach experience through a mixed methodology which allows for greater exploration of their role in skill development, their development and reflection process, and their approach to adopting new tools and concepts to implement with amateur athletes. A series of weekly motivational interviews to discuss these concepts should be included in future research to complement the observational data analysis of training task design.

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5.11 Tables

Table 5. Categorical assessment tool of training task design elements for batting and bowling. Separated into specific feed, decision-making, variability and information elements which are necessary for representative task design in cricket training. A 4-point Likert scale (ratings 0-3) was used to characterise the degree of representative task design in both batting and bowling.

Degree of Task Representativeness				
Score **Description**	0 'Limited'	1 'Partial'	2 'Moderate'	3 'Extensive'
Batting				
Feed	Drop ball	Underarm	Throwdowns	Bowlers
Decision-making	None	(1/3) Contact Direction Consequence	(2/3) Contact Direction Consequence	(3/3) Contact Direction Consequence
Variability	Blocked	Between task	Within task	Within & between task
Information	Feeder only	(1/3) Opponent Teammate Context	(2/3) Opponent Teammate Context	(3/3) Opponent Teammate Context
		Highest Score		12
Bowling				
Feed – Target – Pattern	Empty net Shortened	Stumps Interrupted	Targets Partnership	Batters 6 balls, overs
Decision-making	None	(1/3) Contact Line/length Consequence	(2/3) Contact Line/length Consequence	(3/3) Contact Line/length Consequence
Variability	Blocked	Between task	Within task	Within & between task
Information	Line/length only	(1/3) Opponent Context Teammate	(2/3) Opponent Context Teammate	(3/3) Opponent Context Teammate
		Highest Score		15

Table 6. Descriptive statistics for task design characteristics over 21 sessions throughout the season. Scoring system involved a 4-point Likert scale ranging from 0-3 (see Table 5 for details).

Bowling	Mean ± SD	**Batting**	Mean ± SD
Feed Target	3.0 ± 0.0	**Feed Type**	3.0 ± 0.0
Feed Pattern	1.0 ± 0.4		
Decision Making	2.0 ± 0.0	**Decision Making**	1.0 ± 0.4
Variability	2.0 ± 0.0	**Variability**	2.0 ± 0.0
Information	1.0 ± 0.2	**Information**	0.0 ± 0.4

Feed – how the ball is delivered to the batter, what they are aiming for (target) and how the bowler approaches (pattern).
Decision making – bat-ball contact, direction of the shot (batting) or line/length of ball bowled (bowling) and consequence, (runs, wicket).
Variability – between-task, within-task or combination of both.
Information – sources available in environment: opponents, teammates, context (run rate, match importance, momentum)

Table 7. The level of achievement (%) for key performance indicators in batting and bowling during the 50-over game format (10 games).

	Key Performance Indicators				
Batting	SS %	Singles	P'ship 80	2 x 40+	No r/o
	30%	20%	30%	40%	20%
Bowling	Dot 1st ball	Dot 6th	<15 extras	Dot ball 75%	
	75%	72%	50%	50%	

SS% = scoring shot percentage; Singles = single runs scored throughout the innings; P'ship 80 = a partnership between two batters of 80 runs without a loss of wicket; 2 x 40+ = two partnerships of 40 runs within the innings; No r/o = no run out dismissals for the innings. Dot 1st ball = no run scored on the first ball of the over; Dot 6th ball = no run on the final ball of the over; <15 extras = less than 15 runs worth of wides, no balls, leg byes and byes (unforced errors); Dot ball 75% = no runs scored on 75% of all balls bowled.

Table 8. The level of achievement (%) for key performance indicators in batting and bowling during the 20-over game format (7 games).

	Key Performance Indicators				
Batting	SS %	Singles	P'ship 50	2 x 20+	No r/o
	86%	14%	43%	28%	71%
Bowling	Dot 1st ball	Dot 6th	Extras <15	Dot ball 75%	
	58%	50%	86%	0%	

SS% = scoring shot percentage; Singles = single runs scored throughout the innings; P'ship 50 = a partnership between two batters of 50 runs without a loss of wicket; 2 x 20+ = two partnerships of 20 runs within the innings; No r/o = no run out dismissals for the innings. Dot 1st ball = no run scored on the first ball of the over; Dot 6th ball = no run on the final ball of the over; <15 extras = less than 15 runs worth of wides, no balls, leg byes and byes (unforced errors); Dot ball 75% = no runs scored on 75% of all balls bowled.

Chapter 6 Representative learning design for amateur cricketers

6.1 Abstract

Training task design with amateur female cricketers has typically comprised of deconstructed and monotonous approaches which may not maximise skill development. Clear guidelines to improve these practices in this cohort are lacking. The training environment should provide the same sources of information, decisions and variability as matches in order to prepare players for the match environment, which can be achieved through representative learning design (RLD). An RLD training intervention designed to promote skill development was performed over five weeks with two amateur female cricket teams to provide a framework for community coaches at the foundation stage of cricket. Skill development was recorded as changes in skilled actions for batting and bowling, with cognitions coded as themes for each skill during training. Six of ten batters and seven of eight bowlers exhibited increases in skill development ranging between 7-49%. Changes in batting and bowling behaviour improved substantially between moderately and extensively designed sessions. Batters' thoughts shifted from their own skill execution to objectives, while bowlers focused on their opponent's execution. Moderate to extensive RLD appears to promote skill development in amateur cricketers, making it a viable option for coach education and training design at the foundation level of cricket.

6.2 Introduction

Knowledge surrounding skill development practices in cricket is evolving slowly, with recent research characterising how juniors (Low et al., 2013), female amateurs (Lascu et al., 2020a) and elite male cricketers (Connor et al., 2018) act at training. A preliminary investigation using amateur female cricketers indicated that training practices can be outdated, restrictive and monotonous (Lascu et al., 2020a). With an unchanged approach to training over an extended period despite changes in competition stage, match format and opposition, a lack of variability alone is likely to limit skill development. Furthermore, sources of information for decision making are also commonly absent during training (Lascu et al., 2020a), meaning training rarely provided the information that players would find and utilise in the match environment (Fajen, Riley & Turvey, 2009). These limitations were identified in accordance with contemporary approaches to skill acquisition (Araújo & Davids, 2011) which differ greatly from the information-processing principles of the past (Fitts & Posner, 1967). Current conceptualisations of skill acquisition through an ecological dynamics lens consider the human

body as a complex, adaptive system where movements emerge from interactions between the person, their task and the environment (Davids et al., 2013). The adaptive nature of human movement and constant interactions need to be maintained for a training environment to promote skill development.

When the ecological dynamics approach is reflected in skill development practices, it appears as representative learning design (RLD) (Pinder et al., 2011). This concept emphasises the need to recreate the demands of the performance environment during training if the same desired behaviours are to emerge (Brunswik, 1955). While the game does not need to be perfectly replicated, the key sources of information that players utilise should be present to inform their movements (Warren, 2006). The connection between information and movement is inherent and inextricable, demonstrated in the work by Pinder and colleagues (2011) who captured different, dysfunctional batting behaviours when facing a bowling machine rather than a live bowler. To make a cricket training session more representative of the performance environment, there must be a genuine contest between live bowlers, batters and fielders on an open oval field with a turf pitch (Dicks, Davids & Button, 2009). This setting is a stark contrast to common practices which feature partially enclosed nets to restrict a ball after it has been hit, no real or simulated fielders, and occasional live bowlers often replaced by a player throwing the ball (Low et al., 2013). At the amateur level it can be difficult to access resources like an open field or maintain bowling loads with limited participants at training, so reduced representativeness is expected. As there is little existing knowledge about representative training environments with amateur cricketers, it is possible that minor improvements may be sufficient to promote skill development.

The importance of quality development opportunities at the amateur level in women's cricket is linked to the talent development pathway and growing professionalism (Lascu et al., 2021). As greater investment is directed to state and national organisations, a viable career path is emerging for female cricketers with the capacity to pursue cricket as a full-time occupation. To reach this echelon of success, players can either be selected into junior or senior talent development pathway or vie for selection from their local amateur competition despite a frequent lack of access to facilities and resources (Lascu et al., 2020b). Improving the quality of coaching and training environments in local cricket clubs would provide more female cricketers with the opportunity to progress beyond the foundational stage of cricket.

Attempts to improve coaching practices have been made in the past through detailed planning resources and community learning courses, but they often demand a strong understanding of complex theoretical concepts (Krause et al., 2019). There is a need to provide coaches with practical demonstrations of well-informed practices through training interventions, and case studies, to offer greater insight into how theories like RLD can improve their coaching (Renshaw et al., 2019; Woods et al., 2019). The aim of this study was to implement a short term RLD training intervention designed to improve skill development in amateur female cricketers. New evidence-based knowledge is needed to support a clear framework for future implementation by coaches.

6.3 Study design

A single group feasibility study was conducted with two amateur female cricket teams during the competition season to trial the process of integrating representative learning design into cricket training practices. Outcomes for skilled actions and cognitions were measured through a combination of qualitative and quantitative methods to evaluate skill development throughout a five-week intervention. Therefore, the research question was whether increased representative during cricket training promotes more functional skilled actions and cognitions. This study used a modest sample size at the amateur level and did not maintain a control group within each team to limit disruption to the player's competitive season. A coach was not present for the intervention, so no explicit coaching behaviours or coach-athlete relationship was present during the intervention. As part of the intervention design, instructions were communicated either visually (on a whiteboard) or through a set of instructions by the primary investigator or senior athlete within the team.

6.3.1 Participants

Two amateur female cricket teams participated in this study. Group 1 consisted of nine amateur female cricketers competing in the Premier Cricket competition, Queensland (QLD), Australia (age: 19.7 ± 6 y; match experience: 112 ± 68 games; mean ± SD). Within the group, five batters and four bowlers participated in five training sessions. Group 2 consisted of nine amateur female cricketers competing in the Lynne O'Meara Cup competition, Australian Capital Territory (ACT), Australia (age: 18.4 ± 3.4y; match experience: 106 ± 77 games; mean ± SD). Within the group, five batters and four bowlers also participated in five training sessions. The

study was approved by the Human Ethics Committee of the University of Canberra and participants provided written informed consent prior to the commencement of training for the season after being presented with the purpose, benefits and risks of the study in writing (approval number 20202173).

6.3.2 Training Task Design

This study consisted of a single group training intervention over two separate five-week periods. Each group participated in one training session per week for five weeks and selected a skill-specific goal for the intervention. Self-selected goals were used to establish relevant training objectives and maintain functionality in the intervention design. Batting goals were set as improving the number of singles scored as a percentage of scoring shots (Group 1) and scoring shot percentage (Group 2). The results for Group 1 were therefore based on their ability to score one run, while Group 2 results include all shots which scored a run. For bowling, both groups selected improving dot ball percentage.

The training intervention focused on progressively altering the degree of representativeness for each training session, which reflects how closely the training environment simulates the match environment (Table 10). The training environments consisted of an enclosed netted space, access to an open oval and a synthetic grass pitch. Previous investigations into amateur training practices for female cricketers highlighted that cricket training representativeness varies across four categories (feed, information sources, decision making and variability), but information sources and decision making are often absent or lacking (Lascu, et al., 2020). Table 10 illustrates the progression from ‘moderate’ to ‘extensive’ in training task design. More task representativeness adds greater complexity and sources of information to the training environment, which could provide athletes with more opportunities to act (affordances) and allow skilled actions to emerge when used appropriately. Each training task was designed by the primary investigator in consultation with the participants to compensate for the absence of a coach. The implementation of the feed, decision-making, variability and information sources are detailed in Tables 11 and 12 to identify the available constraints in the training environment.

The feed and decision-making categories in Table 10 detail the constraints that contribute to RLD functionality for a realistic learning context, while task variability and

information sources enable the simulation of game demands. All tasks were designed to include ball feed with a live opponent (batter or bowler). The opportunity to make informed decisions about consequences (runs scored, dot ball) was simulated by encouraging bowlers to detail their field placement and assess the outcome of the ball. Batters could contest this decision by citing key decision-making elements such as bat-ball contact and ball direction. A series of variable tasks (between task variability) and challenges within each task such as a realistic scenario ("*score 10 runs off 6 balls*") were integrated into each session. Information sources which players attune to were gradually introduced, first with a live opponent and a teammate (i.e. batting or bowling partner), then with contextual information such as the current score or wickets remaining (Tables 11 and 12).

To facilitate the objective behaviour (scoring singles/runs), a task constraint of rotating the strike was introduced with the verbal instruction of "*face the least amount of balls*". Achieving the objective behaviour becomes a consequence of completing the task: if you want to face the least amount of balls, you have to get off strike, and to get off strike you have to score a run. Manipulation of constraints requires experiential knowledge of coaches and a clear understanding of the desired behavioural outcome, but also presents a flexible framework for task design.

6.4 Data Collection

6.4.1 Skilled Actions

All training sessions were recorded through front-on video capture in 1080p HD at 30 fps (11inch iPad Pro 2018). During training, the camera was located 5 metres front-on from the bowler's end stumps to capture part of the bowler's approach, follow through and the batter's movements. Through video analysis, subjective measures for batting were collected for quality of bat-ball contact (Muller et al., 2008), force of bat swing (Mann et al., 2010) and rating of footwork technique (Connor et al., 2018) as detailed in Table 9. For the assessment of bowling behaviours, line and length were determined from the same video capture according to Phillips et al. (2012) with consequences (runs/wicket) coded by the primary investigator and reviewed by the research team. A senior researcher worked closely with the coding of the video analysis, with initial codes (runs scored) determined by the athletes during the session by scoring the events as they occurred. The raw data was scanned for errors prior to analysis by the research

panel and regular summaries were reviewed. The research panel also reviewed the coding of the qualitative data by cross-checking each quote. Technical aspects of batting and bowling such as a biomechanical analysis were not conducted in this feasibility study due to the advanced technology and disruption required to capture such information accurately. As the aim of the feasibility study is to allow coaches to replicate the approach to analysis, technical changes in behaviour were not collected.

6.4.2 Cognitions

During each training session, athletes were interviewed at three time-points: before starting their main task of the training session, halfway through the task, and immediately after task completion. Interviews were informal, brief conversational exchanges between the primary researcher and one athlete at the time. When interviewed during a task, the conversation was initiated while the athlete was not actively engaged or in the process of completing a task (i.e., while the batter is at the non-striking end or bowler is returning to their mark). The prompt questions for each athlete included "*Where are you focusing your attention?*" and "*What does success look like for you?*" (Connor et al., 2018). If responses were unclear, clarification questions would follow based on the response of the athlete, such as "*can you describe that for me?"* or "*does that always happen to you?*". Cognitions were captured as an audio file with a Livescribe Aegir Smartpen and the Livescribe+ application to reduce any interruptions to the task and help the athletes feel comfortable discussing their cognitions. All recordings were transcribed by the primary researcher and coded into several categories pertaining to task objective, skill execution, technical skills, task design and emotions (and 3B).

6.4.3 Statistical Analyses

Data modelling involved quantifying changes in outcomes and behaviours for batting and bowling skills as well as cognitive factors. Simple frequencies of batting behaviours (singles scored or scoring shots) and bowling behaviours (dot balls) were converted to percentages for standardisation across the five training sessions. A one-way ANOVA was employed to evaluate means and within- and between-subject variations (IBM SPSS, Version 20). Training sessions for Groups 1 and 2 were analysed separately as 2 x 5 training sessions.

6.5 Results

6.5.1 Skilled Actions

Changes in batting and bowling behaviours were observed in both groups, with individualised responses to the training intervention. Changes in behaviour were determined by comparing the outcomes from each session to the baseline session (Session 1) and batters faced between 24 to 36 balls per session. Improvements in batting behaviours were recorded in Group 1 but not Group 2: Group 1 exhibited a 30% increase in singles scored ($F(2,22) = 4.425$, $p = <0.024$) while Group 2 only recorded a 4% increase in scoring shots ($F(2,22) = 0.656$, $p = 0.511$). Batting behaviour changes differed as training design was altered in Group 1, with improvements notably greater between moderate (67%) and distinct (75%) but not extensive (83%) sessions, suggesting the level of representativeness in training design may facilitate skill development experienced by amateur cricketers. Bowling improvements reached 28% for Group 1 ($F(2,22) = 3.962$, $p = 0.039$) and 26% for Group 2 ($F(2,22) = 6.314$, $p = <0.010$), with a combined change of 27% for both groups ($F(2,27) = 8.714$, $p = 0.002$). Bowling behaviours displayed similar improvements between distinctly and extensively representative sessions, suggesting skill development can occur in both conditions.

Participants responded variably to the training designs throughout the intervention in terms of skilled actions. In accordance with the self-selected goal of scoring more singles, Batters 1, 3 and 5 in Group 1 improved by 11%, 26% and 12% respectively, despite the variety of match experience (11–192 matches). Batter 2 experienced a 32% change in singles scored, which was the highest recording across the two groups, but Batter 4 peaked during Training 2 with 44% before dropping to 21%. In Group 2, scoring shot percentage was the selected goal with Batter 6 gradually increasing by 29% across the five sessions. Batter 10 peaked during Training 4 at 31% while the remaining batters (7, 8 and 9) exhibited little to no change.

The same bowling objective was selected by both groups as dot ball percentage, with marked improvement in four bowlers. In Group 1, Bowlers 1 and 2 recorded improvements of 16% and 32% while Bowler 4 surpassed their initial results by 47%. All bowlers in Group 2 improved differently. Bowlers 7 and 8 demonstrated improvement by 7% and 14% while Bowlers 5 and 6 improved by 37% and 49%. Only Bowler 3 did not improve their bowling performance.

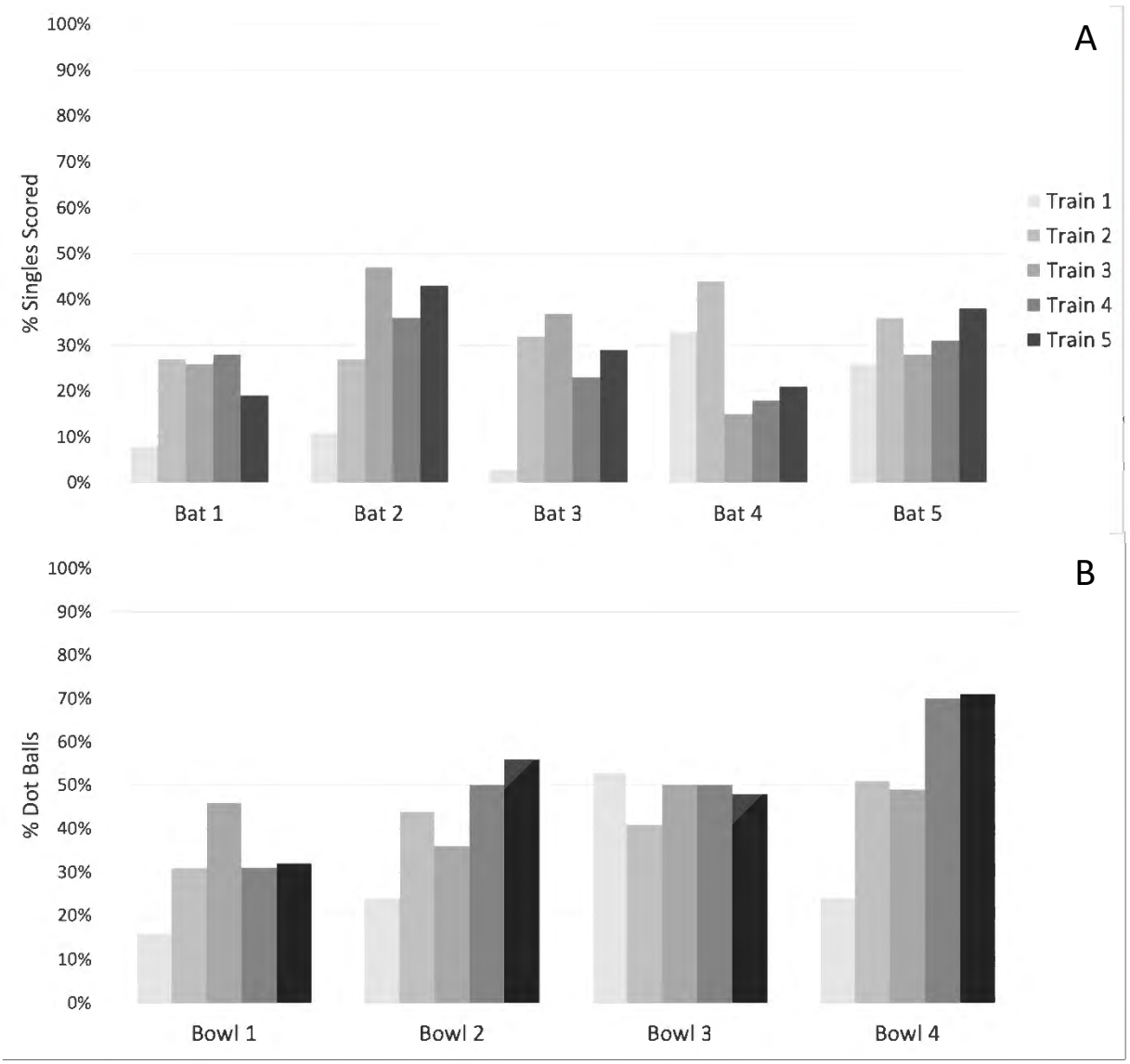

Figure 7. Group 1 results for batting as singles scored (A) and bowling as dot balls bowled (B).

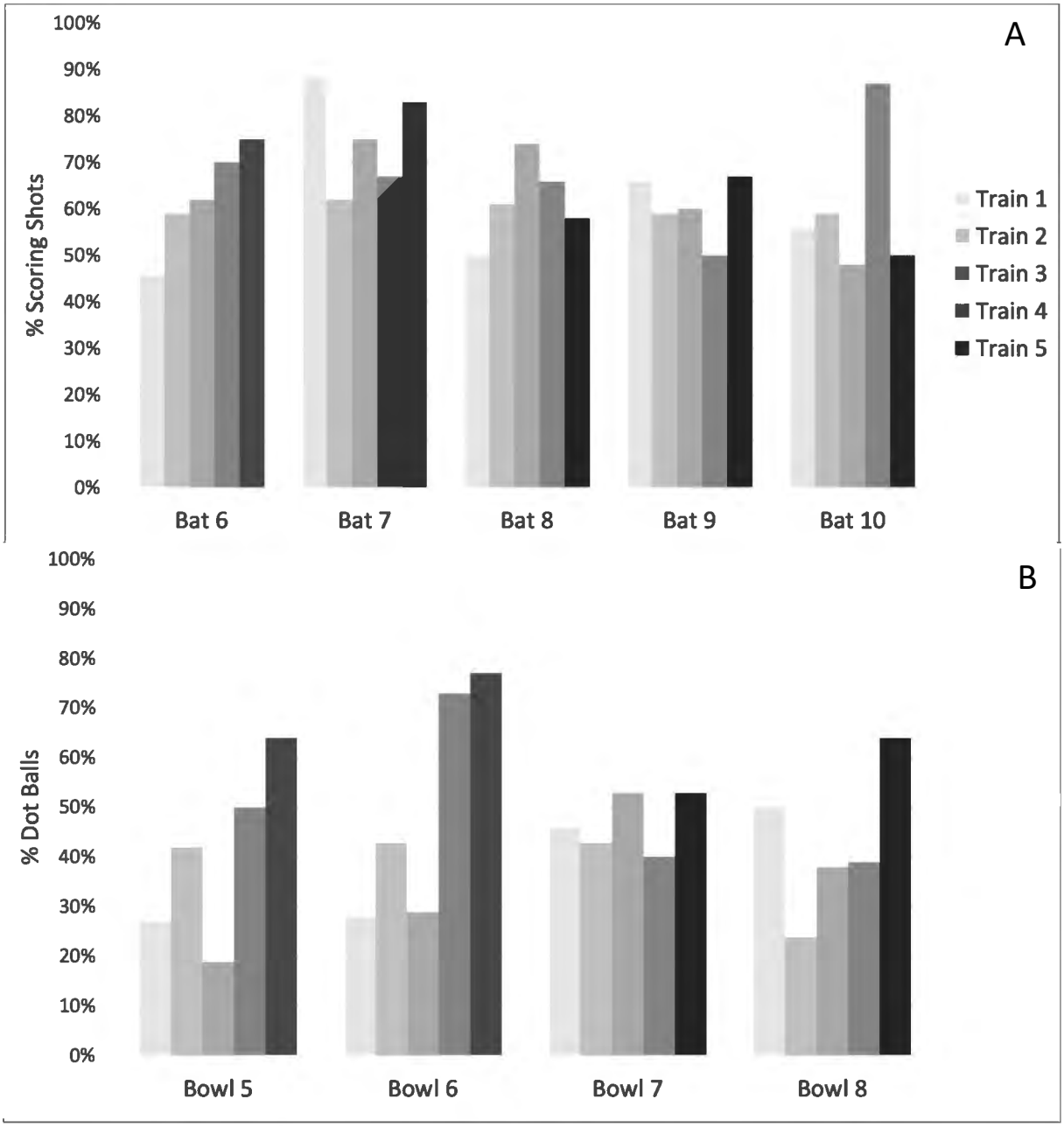

Figure 8. Group 2 results for batting as scoring shots (A) and bowling as dot balls (B).

6.5.2 Cognitions

The primary researcher conducted a thematic analysis on every interview with athletes and coded the responses into several categories of cognitions (Figures 9A and 9B). Categories were labelled to represent the collection of quotes which formed each category, and their prevalence for each training session is represented as a percentage of all responses recorded during that training session. These categories included perceptions of skill execution relating to two

different aspects: 1) the participant's own batting or bowling skill, and; 2) how the opponent executes their skill. For a bowler, athlete interviews detailed that the force of the bat swing or footwork of the batter informed the line and length of their next ball, and vice versa for shot selection of the batters. Own skill execution for batters decreased from 36% to 27% as training representativeness increased, while bowlers focused equally on their own (up to 45%) and opponent's execution (up to 50%). The objective category related to any discussion of the selected skill goal (i.e. scoring runs, dot balls) with the highest prevalence for batters during Training 4 and bowlers during Training 5. Basic skill execution included a focus on rudimentary skills of bat-ball contact or landing the ball on the pitch only, which was only discussed during the first training session (7–14%). Athletes only mentioned making changes to their bowling technique once during Training 2 (9%), and batting technique changes consistently throughout the intervention from Training 2 onwards (28–20%). Negative emotional reactions felt by the athletes such as fear, apprehension, anxiety and uncertainty were consistently low for the batters (7%) and not mentioned by the bowlers (0%) until the most representative session (Training 5) where prevalence increased to 13% for batters and 7% for bowlers (Figures 9A and 9B).

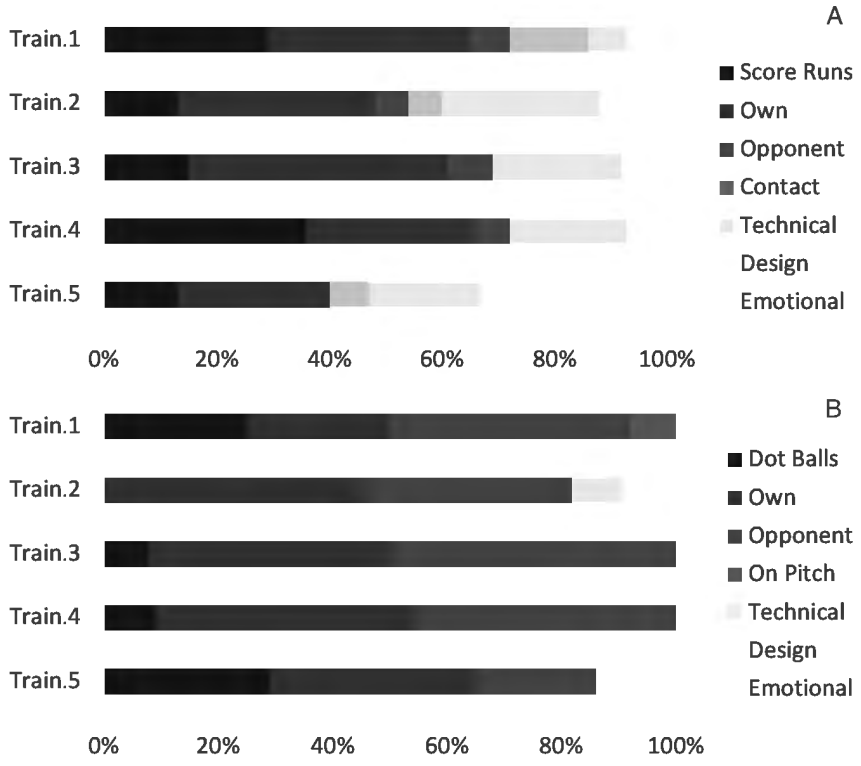

Figure 9. Cognitions for batters (A) and bowlers (B) in Groups 1 and 2, displayed as a frequency distribution in percentage (%) across the five training sessions of the intervention. Categories represent own (execution); opponent (execution); objective (scoring singles or shots); (bat-ball) contact or (ball landing) on pitch; emotional (causes); technical (changes); and (session) design.

6.6 Discussion

In this study, we implemented a short-term training intervention using representative learning design to improve skill development in amateur female cricketers. Measurable improvements in batting and bowling skills were observed across both groups throughout the intervention, with unique responses to the change in representativeness for each session. Six of ten batters improved their ability to score singles or play scoring shots between the first and last week of the intervention, while seven of eight bowlers enhanced their dot ball percentage.

Changes in batting skill during the training intervention differed across individual participants, an expected outcome given the variety of skill levels found within amateur teams. The programming of representativeness throughout the intervention allowed players to become familiar with their new learning environment while challenging them to adapt. Across the two groups, four batters experienced linear changes in batting behaviours as the representativeness

of each training session increased. Their highest score was recorded during Training 5, which was rated as extensive. These batters differed greatly in match experience (5-144 games) implying that an RLD approach can benefit even experienced players by providing robust challenges and opportunity to explore their movements, while also supporting novice players as they build new movement patterns (van Gog, 2005). Longitudinal research in cricket using a similar approach to skill acquisition indicated that batting behaviours like scoring shots and runs scored improve when players are exposed to outcome-focused activities with manipulated rules, which is ultimately more representative of the match environment than traditional approaches (Connor et al., 2016). By creating a framework for community coaches to explore such constraints, and improve the representative design of their sessions, amateur cricketers in local clubs would have greater opportunities to develop their skills.

Not all batters experienced skill development in a linear way throughout the intervention, with three batters peaking during Training 3 or 4. By Training session 5, extensive representativeness was designed into the session by including all of the match elements that players are exposed to, but this may have been overwhelming. Three batters appeared to prefer the distinct representativeness of Training 3 and 4, with Batter 10 in particular dropping 37% between Training 4 and 5. With only 5 career matches by the completion of the intervention, the addition of a scoring scenario (score 27 runs), batting partner and full overs (6 balls in a row) by bowlers, the total experience may have overloaded Batter 10. If too much emphasis is placed on cognitively processing information, this may ultimately disrupt RLD which is underpinned by an absence of conscious thought, instead relying upon the inextricable link between perception and action (Gibson, 1979; Le Runigo et al., 2005). A crucial element of RLD has been the need to sample the match environment entirely, but this may be overwhelming for amateur athletes. Instead, this intervention highlights that improving training representativeness may be more beneficial when introduced progressively and up to a distinct level. RLD can be applied incrementally to improve existing environmental constraints such as enclosed netted environments through thoughtful sampling of information sources (recreating fielders), including decision making elements (runs/wickets) and improving variability (different tasks/challenges).

While changes in behaviour often dominate intervention-based research, it is also important to consider the connection between actions and thoughts/cognitions (Seifert et al.,

2013). As one of the few studies to collect cognition data, the batters in this cohort identified what they were thinking during training. Batter cognitions were dominated by the execution of their own skilled actions, followed by the objective (scoring runs/singles) and making technical changes as they were batting. Some batters noted emotional responses to the activities, especially as the representativeness of the sessions increased, which also inspired thoughts around session design (Figure 9). Despite the lack of experience in some batters, rudimentary goals like bat-ball contact were uncommon and the bowler's execution rarely considered even though batters are known to use cues in the bowler's movements to anticipate where the ball is going (Brenton & Muller, 2018). In the only other study to record cognitions with cricketers, similar categories were identified across amateur and state-level batters with marked differences between the two performance levels (Connor et al., 2018). While state-level batters appear to focus on objective goals (e.g., scoring runs/singles) and technical changes, amateur players shared their thoughts between objectives, and rudimentary behaviours like bat-ball contact and restricting dismissals. It appears that progression from amateur to state-level batter can be seen in a shift of cognitions from an internal focus on one's own behaviours to an external focus, encouraging batters to search for and attune to affordances in the environment.

As the representativeness of the training sessions increased, the batters' own execution decreased as a focus on the objective peaked. Session design factors such as training on an open field rather than enclosed nets influenced the cognitions of some batters such as Batter 10 ("*Not being in the nets was scarier but like, I hit them alright*"). Introducing the batters to new constraints like a grass pitch, which causes the ball to bounce variably, challenged the batters to adapt and explore their movements. This is captured in a quote from Batter 7: "*Waiting for the ball was hard because the grass made it bounce funny*". It is important to consider that amateur cricket training for female cricketers is often in enclosed nets and very repetitive, so changing too many things at once can overpower the learning opportunities of the training environment (Wulf & Lewthwaite, 2016). Some batters, including Batter 3, reported changes in cognition over time which shifted from a preoccupation about their own skill execution ("*I am hitting the ball but I'm struggling*") to a greater objective awareness by the end of the intervention ("*I realised I was getting bogged down earlier this time, so I was able to change my movements to keep scoring runs*"). Scoring more singles and improving scoring shot percentage are functional behaviours that do not necessarily require perfect bat-ball contact or footwork technique. Focusing on the objective may allow players who are restricted by, or

building their current skillset, to experience success in the match by contributing to the team goals.

For the bowling skill component, both groups opted for dot ball percentage as their objective with several bowlers enhancing their skill development by completion of the intervention. Six of the eight bowlers recorded their best results during the final session of the intervention when representativeness was extensive. It appears that bowling in overs at a live batter with either real or simulated fielders and consequences provided a challenging yet supportive learning environment in which the bowlers thrived. The implications for training design are that key sources of information such as consequence (runs, dot ball, wicket) and a live batter should be present for the bowler to utilise. This scenario is also apparent in the cognitions of the bowlers such as Bowlers 6 and 7, which centred on the opponents' execution more than their own execution ("*there's no way they're hitting the cover off the ball if I bowl full")*, and the chosen objective throughout the intervention ("*bowling on grass made me think about how to create a dot ball*") (Figure 9). The competition between a bowler and a batter is the crux of cricket, and while batters appear to utilise the movements of the approaching bowler to anticipate where the ball is going (Muller et al., 2009), bowlers appear to use the batter's movements to indicate the outcome of their delivery. When training critical bowling behaviours, the presence of a live batter is rare which may limit the transference of observations to the performance environment (Phillips et al., 2012). To prepare amateur bowlers for the match, ensuring a live batter is present at training is crucial given bowling success is inextricably linked to how the batter responds.

Given the behaviour changes for batters and bowlers between training sessions, the representativeness of each session appears to have influenced skill development in this cohort. Notably, there was an absence of large improvements between Training 3, 4 and 5 despite the design increasing from distinct to extensive representativeness. This may indicate that a distinct level of representativeness is enough to promote skill development in this cohort without the need for a perfect or exact replication of the performance environment. As this cohort historically experiences restricted training environments, the exposure to extensive representativeness during training may have provided no added benefit by potentially overwhelming the athletes beyond their desired challenge point. Designing perfectly replicated training environments may therefore be an unnecessary burden on amateur coaches and

players, as distinct representativeness provides enough stimulus and information sources to support the development of the athletes. The design principles used in this intervention can form an entry-level approach to RLD for community coaches (Appendix 1). Instead of perfectly recreating the performance environment, coaches should focus on recreating the interactions that players have with their skills, the task at hand, and the surrounding environment to make them think, feel and act as they would in a match. Achieving distinct representativeness as a coach often means designing an extra source of information and changing the feed pattern for bowlers.

Amateur training environments often lack integrated and realistic information sources. By integrating a batting partner and/or simulated fielders as well as bowling in partnerships or one over at a time, the representativeness of the training session improves. Therefore, players have the opportunity to explore and utilise the various sources of information typical of the match environment. Access to information directs players to solve the problem at hand (score runs or dot balls) while in direct competition with their opponent (Table 10). With the core task design components in Table 10 as a guide, task design involves a two-step process of: (1) identifying a missing element in the current training design and; (2) finding a way to integrate that element as it appears in the match environment (Renshaw & Holder, 2010). This guide should make it easier for community coaches to find easy yet significant ways to improve the training environment they provide amateur cricketers.

As a field-based, controlled trial study in a real-world environment, these insights into improving training behaviours are valuable and transferable to other amateur female cricketers and training environments. To understand how training behaviours translate to match performance, future research should include pre- and post-intervention testing in a representative cricket task to assess transfer of skill. The transfer of skills between training and performance environments are believed to be linked by the representativeness of training, which this intervention improved gradually. This may be difficult in an amateur setting where time commitment from players and access to resources is often limited to one regular mid-week training session (90 mins), restricting the potential for overs bowled and balls faced by participants. Capturing expertise in a representative environment has always proven difficult, with a need to maintain the substantial array of information players can access and the complex interactions between themselves, the task and the environment (Renshaw & Gorman, 2015).

For a viable test of skill transfer, and/or the opportunity to provide benchmark testing for coaches during pre-season, players should be exposed to 24-36 balls, as they were during the training intervention. The test also needs to include all of the criteria for task design representativeness on an open field, with preferably a turf wicket, live bowlers and batters in direct competition, live opposition fielders and context (e.g., 24 runs off 24 balls) which allows players to think, feel and act as they would during a match.

Initially, a 7-week intervention was developed to incorporate a pre-test and post-test to assess skill transference into a simulated performance environment but this was disrupted by the COVID-19 pandemic in 2020. The 5-week intervention performed still allowed for a baseline session of moderate representativeness and two sessions each at distinct and extensive representativeness, which minimised the disruption to the season for the participants and allowed for completion before any final series or qualification matches. Skill development is an ongoing nonlinear process, so the observation of significant changes in performance may be limited in this setting. However, this intervention still demonstrates the applicability of representative learning design with amateur cricketers and provides a foundation for future research and coaches to adopt such practices over a longer period of time. Minor changes such as simulated fielders and match scenarios can influence skill development with little need for additional resources or advanced coach development, which ultimately benefits the amateur cricketing community. By managing the complexity of the RLD approach and underpinning concepts, the barrier for coaches and volunteers to adopt new approaches to training in the community should ease (Krause et al., 2018).

Finally, the absence of a coach throughout the training intervention may have emphasised the importance of co-designing the training sessions with the players, but the coach-athlete relationship plays an even greater role in sport (Jowett, Nicolas & Yang, 2017). Including athletes in the design process may have promoted skill development in this intervention, and future research should look to harness the experiential knowledge of the coaches and players to design authentic training experiences. In this intervention, athlete co-design was facilitated by firstly asking the athletes to self-select their goals for the intervention and secondly by negotiating the activities at the start of each session so that they would “faithfully simulate the interacting constraints of competition” (Woods et al., 2020). As amateur cricket has unique constraints, establishing representative tasks to suit their needs is best navigated by

incorporating the personal experiences and insights of the athletes. The role of the coach should be reframed from ensuring that athletes comply with optimal movement patterns and obey instructions to a designer of a learning environment which adequately empowers the athlete to self-regulate towards their own goals and objectives. As such, the absence of a coach in this intervention may have also restricted opportunities for emotional support and guided questioning which contribute to the learning process[34]. This represents a more systemic issue in women's sport with limited monetary support and resources available to support coaches.

6.7 Conclusion

Representative learning design is a holistic approach to skill development which appears to positively impact amateur female cricketers. The foundation stage of the talent development pathway which amateurs occupy is often supported by community coaches and volunteers, so it is important that RLD approaches to cricket are accessible to this cohort. This study provides the groundwork for using RLD with amateur cricketers to complement a coach's experiential knowledge with the empirical evidence in skill acquisition research. It is possible that extensive representativeness is not required to promote skill development in amateur cricketers, so coaches are encouraged to identify one or two elements of training that can better simulate the match environment. Therefore, an enclosed netted environment may still be beneficial if decision-making elements and contextual information are appropriately simulated. The absence of emotional support and individualised approaches in this iteration of RLD with amateur cricketers indicates that the value added by a coach may complement effective training design. Future work is required to design a well-simulated transfer test. Coaches are encouraged to explore the key task design components to reach distinct representativeness and promote skill development in amateur cricketers.

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6.9 Tables

Table 9. Combination of measures to capture key batting behaviours such as bat-ball contact, force of bat swing and footwork. Measures originate from three empirical sources shown in the table.

RATING	Quality of Contact	Force of Bat Swing	Footwork Technique
2	Good contact: Ball contacts the bat face and travels in a direction consistent with the plane of the bat-swing	Complete swing: Complete follow through of bat-swing after anticipated bat-ball contact	Deliberate movement: Transfers weight by stepping forward or backward, and foot is not in motion at time of contact.
1	Poor contact: Ball contacts the edge of the bat or does not travel in a direction consistent with a plane of the bat-swing	Incomplete swing: Incomplete follow through of bat-swing after anticipated bat-ball contact	Readjustment movement: Initially transfers weight forward or backward, however makes a readjustment movement in the final quarter of total ball flight time, prior to contact.
0	No contact: Ball does not contact the bat when the batter attempts to play a shot	Defensive shot: No follow through of bat-swing after anticipated bat-ball contact	Evasive movement: Does not transfer weight forward or backward, or jumps away from the line of the ball prior to contact
	Muller & Abernethy, 2008	Mann et al., 2010	Connor et al., 2018

Table 10. Task design components for Training 1 – 5 with degree of representativeness. Task design components are each scored according to Table 2, with description (%) determined by session score compared to overall score for batting (12) or bowling (15).

	Degree of Representativeness		
Description	**'Moderate' (67%)**	**'Distinct' (75%)**	**'Extensive' (83% - 100%)**
	Batting		
Feed	Live bowlers	Live bowlers	Live bowlers
Decision-making	Contact Direction	Contact Direction	Contact Direction &/or Consequence
Variability	Within & between task	Within & between task	Within & between task
Information	Opponent	Opponent Teammate	Opponent Teammate Context
Score	8	9	10
	Bowling		
Feed – Target – Pattern	Live batters Interrupted	Live batters Partnership	Live batters 6 balls, overs
Decision-making	Contact Line/length	Contact Line/length	Contact Line/length &/or Consequence
Variability	Within & between task	Within & between task	Within & between task
Information	Opponent Context	Opponent Context	Opponent Context Teammate
Score	10	11	13

Table 11. Detailed description of training session designs for batting skills with Group 1 (left) and Group 2 (right) for Session 1, Session 3 and Session 5.

<table>
<tr><td>Group 1 KPI -
↑ Singles %</td><td colspan="2">Group 2 KPI -
↑ Scoring Shot %</td><td>Group 1 KPI -
↑ Singles %</td><td colspan="2">Group 2 KPI -
↑ Scoring Shot %</td></tr>
<tr><td colspan="3">Session 1 – Moderate (67%) Representativeness</td><td colspan="3">Session 5 – Extensive (83%) Representativeness</td></tr>
<tr><td colspan="3">Session occurred in an enclosed netted environment, with 15 minutes allocated per batting pair. Session included live bowlers (Feed = 3/3) and within-task variability (Variability = 2/3).</td><td colspan="3">Session occurred on an open field, on a synthetic pitch (Group 1) or on the open field where one was not available (Group 2). Session included live bowlers (Feed = 3/3) and within-task variability (Variability = 2/3).</td></tr>
<tr><td>Design Focus</td><td colspan="2">Decision Making (2/3)
Information (1/3)</td><td>Design Focus</td><td colspan="2">Information (3/3)</td></tr>
<tr><td colspan="2">A consequence to the action was added through the addition of markers as fielders within the net, also providing opponent information about field placement.</td><td>A consequence to the action was added through the addition of markers as fielders within the net, also providing opponent information about field placement.</td><td colspan="2" rowspan="3">Batters were given a teammate as a batting partner and developed a specific scenario based on a realistic run chase. Batters were tasked with setting an odd number of runs (needed to use singles to achieve score where possible). Runs were determined by running between wickets and shortened boundary (40m) with a standard field placement.</td><td rowspan="3">Batters were given a teammate as a batting partner and set a specific run chase for the 24 balls they were allocated. The score was encouraged to be a “run a ball” (24 runs) to encourage scoring off every ball (and increasing scoring shot percentage). Runs were determined by running between wickets and shortened boundary (40m) with a standard field placement.</td></tr>
<tr><td colspan="3">Session 3 – Distinct (75%) Representativeness</td></tr>
<tr><td>Design Focus</td><td colspan="2">Information (2/3)</td></tr>
<tr><td colspan="2">A batting partner was provided (teammate information source) and the objective was encouraged by prescribing a fitness exercise to the bowlers for every single scored.</td><td>Rotation of the strike was encouraged with the instruction “face the least amount of balls” within each batting pair, with the batting partner as a teammate information source.</td></tr>
</table>

Table 12. Detailed description of training session designs for bowling skills with Group 1 (left) and Group 2 (right) for Session 1, Session 3 and Session 5.

<table>
<tr><td colspan="4">Group 1 and Group 2 KPI - ↑ Dot Ball %</td></tr>
<tr><td colspan="3">Session 1 – Moderate (67%) Representativeness</td><td>Session 5 – Extensive (83%) Representativeness</td></tr>
<tr><td colspan="3">Session occurred in an enclosed netted environment, with 15 minutes allocated per batting pair. Session included live batters (Feed Target = 3/3) and within-task variability (Variability = 2/3).</td><td>Session occurred on an open field, on a synthetic pitch (Group 1) or on the open field where one was not available (Group 2). Session included live batters (Feed Target = 3/3) and within-task variability (Variability = 2/3).</td></tr>
<tr><td>Design Focus</td><td colspan="2">Information (2/3)</td><td>Design Focus Information (3/3)
Feed Pattern (3/3)</td></tr>
<tr><td>Context was added by setting a scenario for the bowlers to achieve. If they bowled 3 dot balls out of 6 balls, they would win the over.</td><td>Context was added by setting a scenario for the bowlers to achieve. If they bowled three back-to-back dot balls, the batter would be out.</td><td rowspan="4">In the open field, bowlers would compete in 6-ball overs to maximise feed pattern. Batters would select their desired runs total (context) and two bowlers would compete to restrict their runs. For every maiden over (6 dot balls), the batters would complete a fitness punishment at the end of their innings.</td><td rowspan="4">In the open field, bowlers would compete in 6-ball overs to maximise feed pattern. Batters would select their desired runs total (context) and two bowlers would compete to restrict their runs. Limited fielders were available, so bowlers were encouraged to strategically place the available fielders. A synthetic pitch was not available so bowlers were encouraged to utilise the variable bounce in the grass to their advantage.</td></tr>
<tr><td colspan="2">Session 3 – Distinct (75%) Representativeness</td></tr>
<tr><td>Design Focus</td><td colspan="2">Feed Pattern (2/3)
Information (2/3)</td></tr>
<tr><td>Bowlers were paired with a teammate and would alternate bowling (every 2nd ball to improve feed pattern).They were encouraged to develop a strategy to bowl 4 dot balls out of 6 balls.</td><td>Bowlers were paired with a teammate and would alternate bowling (every 2nd ball to improve feed pattern). They were encouraged to develop a field setting which suited both bowling styles to maximise dot balls.</td></tr>
</table>

Chapter 7 Discussion

7.1 Summary of outcomes

Our understanding of sport science, and more specifically, talent development has been predominantly built on the experiences of male athletes. Research into human movement, expertise and talent development often focuses on elite male athletes, shaping our knowledge of athlete behaviours and experiences in an exclusive way. This position is reinforced by sports that are perceived as 'male-dominated' and consequently all women's sports suffer from the consistent underrepresentation of female athletes in research. However, recent societal shifts in gender equality have inspired change and a growing focus to study women in sport. Sport now presents women with greater opportunities to pursue a career in a multitude of sports and even achieve professionalism. Recognition for women in sport has transformed for the better, due to the first all-female tennis tour of 1971, and the ICC T20 Women's World Cup Final in March 2020 with 86,000 spectators and 1.2 million viewers (Lemon, 2020). However, there is still room for improvement, as female athletes earn less for professional pursuits in sports than males and rely on access to facilities and resources for remuneration (Abrams, 2019). Ongoing success on the international stage has increased television broadcasting and visibility for female athletes in various sports, but the development of expertise of women cricketers remains unclear in contemporary research.

With greater exposure, support and recognition, participation is likely to continue to grow at an exponential rate but there is little evidence to inform approaches to talent development with future athletes. For sporting organisations becoming increasingly invested in their female athletes, there is little direction regarding how to tailor athlete development practices and sporting competitions. This persistent lack of understanding or empirical knowledge may make it difficult for female athletes to receive the support they require, and ultimately deserve to succeed, as professionalisation of women's sport advances. The responsibility, and opportunity, to create a sustainable future for women in sport now rests with sporting organisations, coaches, and talent developers, and research will play an important role in informing their approaches. There is a growing demand for sustainable and supportive pathways for talent development which benefit athletes from the local amateur level to elite performance - a priority that has been echoed in sport science for decades (Martindale et al.,

2005). With growing concern for the detrimental psychological effects of identification-based approaches to talent development, a more holistic and developmental approach is required.

The impetus to apply a holistic approach to talent development was met, in part, by this program of research by maintaining the inter-relatedness of physical, psychological, environmental and contextual factors throughout the investigations. The need for a transdisciplinarity approach in sport science research was also addressed by capturing multiple perspectives of talent development, observations of and interventions with underrepresented levels (amateur athletes) and building a grounded theory of professionalism to capture the authenticity of the female athlete experience. A disconnect between current talent development practices and contemporary research was identified, with recommendations made for improving future practices through an informed and evidence-based coaching framework. Potential areas of improvement in talent development for female cricketers, including the advancement of community coaching practices and professionalism in the sport, were explored at the organisational and implementation levels. These recommendations are complemented by suggestions for future research, such as the development of a skills framework to better observe talent development, and integrating contemporary task design principles with current coach education programs.

7.1.1 Talent development practices

As one of the first in-depth investigations into talent development practices in cricket and female athletes, a primary aim was to determine whether current practices align with existing research. First, a notable disparity between talent development practices and intended organisational outcomes was identified in the structure of the talent development pathway. Traditionally, leading officials and coaches believed the pathway to elite status within cricket operated nonlinearly, which allowed athletes to move freely between various stages of the talent development pathway as they learn and develop. However, in a qualitative study involving elite female cricketers and their coaches, all athletes reported following a linear ascension by entering as a 12- or 15-year-old and graduating through each subsequent stage. This aligns with common talent identification processes which have been called into question in the past decade as world-class athletes are known to start training, competing and participating in international championships significantly later than their less successful peers (Vaeyens et al., 2009). This linearity may be perpetuated by the absence of aims, goals or skill

competency frameworks to map how or why athletes are progressing between each stage. It is increasingly difficult for athletes beyond the pathway to identify their entry to programs or pathway if they miss out on early identification and/or selection between 12-15 years old. The current ambiguity surrounding how players enter, exit or graduate the talent pathway places an inadvertent emphasis on talent identification, instead of talent development. Talent identification prevails despite the difficulty of separating advanced skill development from early maturation (Partington & Cushion, 2013).

While a linear pathway to elite status is not inherently problematic, it may not align directly with the nonlinear nature of human development. Rather than graduating through predetermined stages of learning (Fitts & Posner, 1967), more contemporary approaches to human development and skill acquisition have re-cast the development pathway as a nonlinear process (Davids et al., 2012). Human movement develops from constant interactions between a person, their surrounding environments, and the tasks they complete or problems they learn to solve (Davids et al., 2013). To reflect the way athletes learn and develop, a talent development pathway should also appear nonlinear by allowing athletes to freely move between, enter or exit stages as they develop. This premise is predicated on athletes and coaches being able to identify key skill characteristics at each stage of the pathway, and athletes accessing ongoing development in local communities beyond talent programs. Currently, coaches and athletes are unable to identify skill and talent development accurately in cricket, resulting in unidentifiable goals for each stage of the talent development pathway. Despite being a staged process advancing from fun and engagement to talent programs and competitions (Gulbin et al., 2013), there is a lack of specific criteria, skill guidelines or competencies to meet before progressing through each stage.

Chapter 3 examined the way female cricketers experience the talent development pathway and highlighted that it is unclear why or how athletes advance to the next stage. Aside from making it difficult for athletes to gauge their development or map their pathway to elite status, this ambiguous approach to talent development also perpetuates the need to appear talented at a young age and gain early selection into talent development programs (Renshaw et al., 2009). The future development of new female cricketers who are attracted to the game at a later age by family, friends, role models, or elite athlete exposure on television may be limited without specific goals, aims, or structure to the talent development pathway. Chapter 4 also

highlighted that cricket is becoming a more viable sport and career option for young females, which is a necessary advancement as female participation continues to grow (Ramsey, 2020). The absence of guidance and purpose in the current talent development pathway could be excluding future athletes before they reach their potential. To ensure that both new and established athletes are supported, access to quality talent development opportunities beyond selection-based programs is a priority for players to continue developing at their own unique rate.

For current elite female athletes, a key developmental experience appeared to be participating in boys/men's cricket. Cricket has historically been less accessible for female athletes but those determined to play would fit in with their brothers, fathers and friends despite not always being welcome. In Chapter 3, coaches were able to identify athletes who had engaged in boys/men's cricket, emphasising that their advanced skill development likely came from this early interaction with competitive cricket. It remains unclear whether their development surpasses those of their teammates who only played cricket in girls' teams, and which particular elements of boys/men's cricket assisted with advancing their skill development. It is possible that being surrounded by other skilled athletes encouraged young female cricketers to 'rise to the challenge', entering a zone of proximal development when supported and encouraged (Vygotsky, 1978). There are also suggestions that some traumatic experiences in the form of life challenges are common in the development of talented athletes, such as failing to meet performance expectations or participating in demanding training environments (Savage, Collins and Cruickshank, 2017). Overcoming these challenges may provide athletes with a skillset that complements their technical and physical capabilities through learned resourcefulness, but individualised support is highly recommended in order to maintain the balance between challenge and development (Collins and MacNamara, 2012). It may be that boys/men's cricket offers young female cricketers a more challenging, and therefore stimulating, environment given the unique social dynamics of being 'the odd one out' and wanting to outperform their peers. Conversely, young female cricketers may be exposed to a competitive environment that is designed to reinforce the development of expertise, rather than solely participation.

To accommodate the growth of female participation in cricket and provide a safe training and competition environment for new players, the prevalence of all-girls teams and

competitions has increased. The initiative to keep new cricketers with their peers and explore enjoyment-based competition structures may be useful for participants, but young female athletes who are more skilled or experienced than their peers may not fit in these environments either. While these skilled youth female athletes would normally compete in boys' cricket, the existence of all-girls programs now makes it increasingly difficult to continue this developmental path, potentially limiting the develop of determined young athletes. Further, investigation into the elements of boys/men's cricket which promote advanced skill development should be undertaken to help coaches, and sporting organisations, recreate these functional learning environments to support athletes pursuing elite status.

A philosophical shift towards nonlinear and holistic approaches to development is required to relinquish talent identification and future-proof talent development practices (Vaughan et al., 2019). This shift begins with recognising that the interaction between a person and their environment shapes their behaviours and extends to ensuring all cricketers have access to high quality and ongoing development opportunities in an accessible location such as local cricket communities. The basis of a nonlinear approach recognises that human development, and therefore talent development, does not occur in a linear way or through predetermined stages so sporting systems and structures should be flexible enough to accommodate this (Chow, 2013). Chapter 2 contextualised the nonlinear approach in cricket by grounding relevant research and identifying the components contributing to personal development, task design and environmental constraints. In contrast, for the athlete cohort in Chapter 3, a linear progression through each age group was a common trajectory through the talent development pathway. If programs recognise that talent development can occur at later ages, and through exposure to various learning environments at different times or places, then female cricketers need to be provided with training environments which are more stimulating and supportive than observed in Chapter 5. To accommodate the variety of female cricketers hoping to reach their potential within the sport, coaches should reconsider how skill acquisition knowledge can be applied to the talent development practices (Lee et al., 2014). The key elements are how athletes are selected for talent programs, how community cricket is structured, and how coach education is designed.

With greater insight into training design and coach education practices, as well as how talent is quantified in female cricketers, athletes could access a quality talent development

opportunity by attending training at their local cricket club without requiring an invitation to selection-based talent programs. With the development of new coaching frameworks based on skill acquisition principles as described in Chapter 6, improving the practices of community cricket coaches may be achievable. While the nonlinear approach to talent development would mean that an adequately skilled amateur cricketer has equal opportunity to enter into and continue down the talent development pathway, the lack of clear aims and skill guidelines currently surrounding the pathway makes this difficult to implement. The biggest setback to applying a nonlinear approach is likely the universal change required at both organisational and implementation levels. First, a greater understanding of how talent is quantified must be established, building on the works of Weissensteiner (2008) by maintaining the integration of physical, psychological, tactical, emotional and contextual factors when viewing talent, and understanding how coaches or selectors observe these elements. The key here is not to forego the holistic nature of talent and its development to create a 'quick fix', instead focusing on the complexity and difficulty that talent naturally presents and developing robust empirical methods to authentically capture it (Toohey et al., 2017; Vaughan et al., 2019). Secondly, how coaches develop their practices, and the role of coach education should also be investigated to understand how approaches like representative learning design, as demonstrated in Chapter 6, may be integrated at the community level. With an informed coaching framework, a universal understanding of talent for female cricketers and supportive learning environments in community cricket clubs, cricket could serve as a guide to the future of talent development for female athletes.

7.1.2 Amateur training practices

Community sport and amateur athletes form the foundation stage of the talent development pathway, with the responsibility of their development often falling upon volunteer coaches. Task and training design play a pivotal role in skill development, but existing work in skill acquisition does little to bridge the gap between research and practice due to its complexity. Cricketers from all stages of the pathway interact in local amateur cricket competitions, creating a melting pot of knowledge and skill. As one of the first talent development opportunities for experienced and new cricketers alike, training practices in local clubs influence all participants irrespective of their background and status and provide the platform to pursue elite status or lifelong participation. When amateur training practices with female cricketers were evaluated in Chapter 5, they did not appear to align with skill acquisition

principles and recommendations in research, indicating the foundation of skill development for female athletes may be compromised.

Over one cricket season with an amateur female cricket team, training practices were often deconstructed, invariable and monotonous, making training less effective in preparing athletes for the complexity of cricket. As detailed in the observational study in Chapter 5, the training experience of athletes was typically limited to four batters in a partially enclosed net, batting for 10 minutes while several bowlers each delivered one ball at a time. This scenario is a stark contrast to the complex interactions between a live bowler and batter in an actual match, surrounded by fielders in an open field with additional contextual information and pressure. Contemporary approaches to skill acquisition highlight that athletes are capable of identifying and harnesses sources of information in their task and environment subconsciously (Pinder et al., 2011). However, current training practices in cricket are yet to reflect or cater for this categorisation of human learning.

To help coaches understand the need for representative learning design and training environments, they must first understand the elements in their command. A coaching tool was developed in Chapter 5 involving task design elements that can be manipulated at a cricket training session. Separated into the four categories of feed, decision-making, variability and information sources, this coaching tool categorises the concepts of perception-action coupling, ‘repetition without repetition’ and visual anticipation into observable design elements. While these concepts are highly prevalent in cricket, the empirical language used to describe them can make it difficult for coaches to understand and implement. For example, perception-action coupling, where what we see informs how we act and vice versa (Gibson, 1979; Warren, 2006), is closely tied to visual anticipation in cricket. For example, batters are known to utilise information in their task, environment and opponent to ‘predict’ where the incoming ball might be (Regan, 1997). This scenario is often seen when batters appear to have ‘all the time in the world’, even when the ball is travelling at a high speed. On the contrary, emergent behaviours can also be seen as different, even dysfunctional, movement patterns when batters face a ball projection machine compared to a live bowler because some information sources, like approaching bowler kinematics, are not available. Assisting coaches to integrate their experiential knowledge of cricket and coaching with the contemporary concepts that encompass skill acquisition should empower them to change their coaching approaches. If the

foundation level of the talent development pathway is to cater for an influx of female cricketers, and provide a platform for pursuing elite performance, then improving community coaching practices is the most effective way to develop these players.

Coach development is currently centralised through state and national sporting organisations, with a recent shift towards supporting athletes and creating engaging activities during the one-day introduction to coaching course. In Australia, a significant amount of effort and investment has gone into the development of resources to provide ongoing support through phone applications and interactive videos with examples. Even the skills developed within cricket have been reframed from batting to "scoring runs" and bowling to "taking wickets" to emphasise the desired outcomes of a skill and to ensure this is explicitly addressed during training practices. While these resources are undoubtedly helpful, they take a "show and replicate" approach that contrasts with the coaching behaviours that a skill acquisition perspective would recommend. Instead, coaches should be empowered to tailor their training environment to suit the unique demands of their sport, their competition level and their athletes. There is a plethora of knowledge which continues to grow regarding how to achieve this, through the manipulation of constraints or simulated game play, but this knowledge should be communicated in a way that is digestible for the average volunteer community coach. Rather than prescribing a series of thoughtful, well-developed activities, the next phase of coach development should focus on empowering coaches to develop such activities themselves, potentially co-designing those activities with their athletes to improve their ability to design an effective and supportive learning environment.

7.1.3 Representative learning design benefits amateur cricketers

The premise of representative learning design (RLD) is to provide athletes with a training environment which simulates the thoughts, feelings and actions required in the game environment (Pinder et al., 2011b). Preparing athletes for the demands of 'game day' by recreating these demands at training could help functional behaviours transfer between one environment to the next. It is the responsibility of the coach to identify and reconstruct the key sources of information that players utilise while performing. While Chapter 6 provides an introductory framework for preparing an RLD approach to cricket for amateur female athletes, some intended outcomes were not achieved. Initially, a collaborative approach to the design of training was proposed to incorporate the experiential knowledge of the coach on cricket, and

their athletes, but the coach was absent for the amateur female cricketers in this study. While this shortcoming reflects how difficult talent development can be for individual athletes who rely on their local cricket environment to improve, it also highlights the issue that any approach to improving coaching practices must be effective and well-informed. The task design tool in Table 10 may direct a coach's attention to critical elements, but the acute design of training should encompass a constraints-based approach. This means that actions should be guided by boundaries designed into training so athletes can explore their movements and solve game-related problems (i.e., scoring runs or bowling dot balls). For example, to help players identify a source of information such as the context of the game, a realistic game scenario may be added to a training activity, whereby the batter must score 10 runs off the last 6 balls to win. If a player is exposed to this type of stimulus in their training environment, they have access to the information needed to skilfully navigate a similar scenario in different contexts.

Further development of the task design tool for coaches was made in Chapter 6, where the RLD intervention conducted with the players is detailed in Tables 11 and 12. While the session designs serve as a useful template, it is likely that coaches require a sense of autonomy before they can alter their coaching behaviours, as other examples of self-regulated learning have shown (Renshaw, Oldham & Bawden, 2012). To inspire coaches to continue their learning beyond formal professional development, an interactive tool was developed to guide coaches through an RLD process. A key element of this tool was providing a filter to determine the desired degree of representativeness in the training environment. As seen in Chapter 6, the changes in skilled cricket behaviours between distinct and extensive representativeness were indiscernible. Without a gradual progression towards a fully simulated game environment, training with all elements of RLD may be too complex or overwhelming for some amateur cricketers to navigate at once. Coaches may need to consider this issue when they set challenging or complex tasks and be prepared to emotionally support their athletes. It is also possible that only a moderate level of representativeness is required to promote skill development at the amateur level. Athletes can be introduced to game elements they may have never experienced before at training, such as knowing how far the ball travels off the bat, or whether a ball bowled is a wicket. The role of athlete emotions and cognitions (thoughts) in shaping their individual actions should also be considered when designing training tasks and learning environments (Headrick et al., 2015). The coaching tool in Appendix 3 uses task difficulty in Step 1 to determine how many training design elements should be in the session,

but also proposes a 'player readiness' index in Step 3, which helps coaches co-design the session with their athletes. The importance of co-design in coaching has recently been emphasised to promote athlete-centred learning (Woods et al., 2020), which encourages coaches to consider the learning needs of players when designing tasks. Athlete-centred coaching and co-design remains a novel concept to many community coaches, and some guidance may be needed to initiate conversations and guide questioning.

The program of research in this thesis provides preliminary evidence for integrating representative learning design into cricket coach education with particular reference to amateur female athletes. If coaching in local cricket communities can improve, then cricketers would have increased access to quality development opportunities, ultimately supporting the ongoing growth of female participation and expertise. These initiatives have the potential to support a nonlinear pathway if coupled with a framework founded in empirical and experiential knowledge for coaches to harness. Community cricket could permit more athletes to reach their potential in their own time if coaches receive some guidance when harnessing skill acquisition concepts to build more engaging, affordance-rich and supportive training environments. This outcome is only possible when a clear understanding of expertise is available, and all athletes can access quality learning experiences through supportive coaches.

7.1.4 Professionalism in cricket and women's sport

The implications of studying professionalism in women's sport extends beyond cricket, but as one of the most recognisable brands and teams, the journey of Australian Women's Cricket Team is an exemplar worth considering. Through the experiences of administrators, coaches and ex-athletes from previous generations, a grounded theory of professionalism in women's sport was developed in Chapter 4. As a key finding in the investigation of perceptions and practices in talent development in Chapter 3, professionalism evolved as a commonly used word with many interpretations. A distinction was made between the professional behaviours and expectations of athletes, and the way organisations treat their athletes as professional, through remuneration and access to resources, which can both be referred to as professionalism in sport. This aligns with the "erosion of amateur beliefs and attitudes" highlighted by Kjær and Agergaard (2013), where athletes have undergone an evolution of how they act and how they are treated. A key definition of professionalism was also identified, indicating that a professional athlete is defined by their ability to pursue sport as a career similar to any other

athlete, and be paid accordingly, even at the domestic level. According to this definition, the skill gap between amateur, domestic and international athletes is likely to continue to grow if talent development practices do not improve in local communities.

The rise of professionalism in women's sport does not appear to evolve as athletes become more masterful, but rather marketable. In cricket, the push to promote the expertise of the Australian Women's Cricket Team did not come from their dominance on the international stage and World Cup wins, but to appeal to a female audience (Chapter 3). Development of the most successful domestic competition for female cricketers in the world was largely underpinned by the strategy of broadcasting female cricketers in a way that is easy to consume. There was also a substantial effort made to convince families to attend local matches in metropolitan and rural areas alike. On a positive note, these initiatives have ultimately paved the way for young females to identify new heroes and role models who help combat the 'you cannot be what you cannot see' conundrum (Kelly, 2020). However, not all sports see their female athletes as an investment opportunity. The popularity of, and connection to, sport as being male dominated comes largely from the consistent underrepresentation of female athletes in the media, with male sport dominating the airwaves historically and currently. If a sporting organisation expects their athletes to perform at a professional level, then athletes should have access to the appropriate support structures, resources, facilities, services and remuneration to allow the necessary level of dedication and preparation. Higher standard coaching and playing should generate enough revenue for players to receive monetary remuneration for their professional performances.

Broadcasting, sponsorship and commercial deals likely underpin many male competitions, teams, and athlete salaries, which is in turn dependent on how many people watch or subscribe to the sport and/or purchase merchandise. Therefore, there must be a product to sell and for female athletes, this must be their expertise, competitiveness and athleticism, rather than solely their appearance. To develop expertise, a strong foundation of talent and skill development throughout childhood, adolescence and young adulthood, is required with a philosophy aligning with best practice learning and education. Talent development practices are currently undermined by a reliance on talent identification, which places external pressure on athletes to develop and perform and increases the risk of detrimental psychological effects such as burnout (Brenner et al., 2019). Navigating the development of young athletes should

be undertaken with a flexible framework balancing the nonlinear nature of physical growth, tactical understanding of the sport, and the inspiration to pursue sport as a career. Creating a space for women in sport that is sustainable, liveable and rewarding is a holistic process like talent development. Women's sport cannot advance by simply putting games on television, however gaining that visibility and support is the first step after ensuring that athletes are in a position to prepare and perform professionally.

Developing a sustainable level for women in sport is a long-term commitment with profound impacts beyond the professional sporting realm. Beyond the billion-dollar economic incentive of supporting women to reach the recommended levels of daily activity (Women in Sport Organisation, 2019), the societal demand for equality has also reached many sports and highlighted how unjust sporting experiences can be between male and female athletes. Poor quality livestream services, empty stadiums, merchandise with no women's sizing, and a consistent sidelining of women's sports in the media has been the reality for female athletes in the past. However, when all sports halted during the global COVID-19 pandemic in 2020, there was an outcry to do better. As sports continue to navigate the realm of professional sports with their female athletes in a post-pandemic world, it is critical that their investment is targeted and effective. There is an opportunity to forge a new path of visibility, to promote the expertise and athleticism of female athletes in a new way, and inspire more women to become active, compete, and reach their sporting potential. It is a collective responsibility of stakeholders in the cricket community to ensure that the world of sport is just as accessible for girls/women as it is for boys/men, and equalising professionalism is a step in the right direction.

7.2 Implications of practical outcomes

7.2.1 System level:

- Existing talent development practices with female cricketers do not align with evidence-based recommendations and may not be suited for future female cricketers.
    - The reliance on talent identification only benefits athletes who appear skilled at a young age and may not accommodate new female cricketers drawn to the game with transferable skills and learning potential.

- The lack of clear aims, goals or objectives for the different stages of the pathway make it difficult to identify why athletes enter, exit or graduate from the pathway.

- In turn, athletes may not be able to track their development or achieve later entrance to the pathway without understanding the criteria for entry.

- A nonlinear pathway is only possible when each stage of the pathway is aligned and clearly defined, making it possible for athletes to transition in and out of programs as they grow.

    - Athletes should be able to access quality talent development opportunities in other ways, such as local cricketing communities or rural areas.

    - Skill guidelines or competencies should be established in a way that supports nonlinear development so navigation of the pathway becomes clearer.

- The development of policy and strategy that specifically recognises and supports female athletes should be a priority for Cricket Australia.

    - Further research enquiry into the key developmental experiences of female cricketers, including longitudinal studies assessing the engagement in development activities (boys cricket, all-girls cricket, entry-level programs, schools etc).

    - Strategy and/or programming which clarifies the role of the talent development pathway, including the key outcomes which should result from involvement in talent and community programs.

    - Stakeholder education regarding nonlinear development, including staff responsible for talent pathways and selection, as well as parents and athletes regarding entry criteria and how to navigate the talent pathway.

7.2.2 Implementation level:

- Community coaching practices are the cornerstone of talent development, but they may currently limit skill development for female cricketers at the foundation stage of the pathway.

- A growing skill gap is emerging between stages of the pathway, particularly the foundation and elite stages.

- To increase participation and support more athletes in their development, community coaching practices need to improve.

- Representative learning design has the capacity to promote skill development in amateur female cricketers by providing coaches with a well-informed framework.

    - Amateur training practices often lack decision-making elements and sources of information which may encourage dysfunctional behaviours to emerge.

    - A coaching tool to support community coaches should outline the constraints that they can manipulate, allowing them to construct unique tasks for their athletes and build their own autonomy and self-efficacy.

- Coaching accreditation levels and requirements should be updated to reflect ecological approaches to skill and talent development, implemented at the Community and Talent levels.

    - Promotion of engagement-focused activities and practices to specifically facilitate the development of female athletes by coaching for emotional regulation, self-determination, psychological safety and building a coach-athlete relationship.

- Support a national review of participation programs and delivery to promote awareness and implementation of above recommendations.

    - Development and implementation of a skills curriculum, informed by enquiry into athlete development and ecological approaches.

    - Aligned coach education empowers coaches with representative learning design concepts, with regular opportunities to upskill between accredited courses and/or the development of a professional learning community.

7.3 Future research directions

7.3.1 Boys/men's cricket

- More information is needed on key developmental experiences that could advance the skill development of current elite and sub-elite female cricketers. Detailed qualitative research studies in the form of surveys and structured interviews, similar to those used in this thesis, would be an appropriate approach.

- The experience of boys/men's cricket likely differs from the experience of current all-girls cricket teams. Comparative studies of both boys and girls cricket are needed to identify differences in experiences and coaching approaches to gauge their short- and long-term implications.

7.3.2 All-girls cricket competitions

- The experiences of various players in all-girls cricket competitions need to be captured to understand how new, experienced, highly skilled or unskilled players interact with cricket. An observational study, similar to Chapter 4, would be appropriate to detail the acute elements of coach interactions, training design elements, and player emotions which are yet to be fully characterised in young female cricketers.

7.3.3 Establishing skill guidelines with a holistic approach

- The ambiguity surrounding the purpose and entry requirements of the talent development pathway could be addressed by establishing skill guidelines or frameworks. To identify the holistic characteristics of expertise in cricket, further research is needed to understand why players gain selection into talent programs and how coaches/selectors identify skills.

- It may also be possible to determine a robust way to capture, and predict, the highly contextual and adaptive skills which meet the demands of elite cricket. Most importantly, any skill guidelines or framework should not be prescriptive, rather, act as a road map to help developing cricketers chart their skill progression and align coaching practices.

7.3.4 Coach education experiences and/or integration of RLD

- Representative learning design (RLD) appears to be useful for skill development with amateur cricketers, but whether it currently exists in coach education and how coaches learn to implement new coaching strategies is unclear. A review of current coach development practices and teachings should be conducted, with ongoing investigations of behaviour change to examine if coaching practices are influenced by education.

- Interviews with coaches who have begun to explore RLD approaches themselves, how they have acquired this knowledge should also be undertake, and further development of the research conducted in Chapter 6 should be made to understand any concerns, questions, and the experience of coaches when using RLD.

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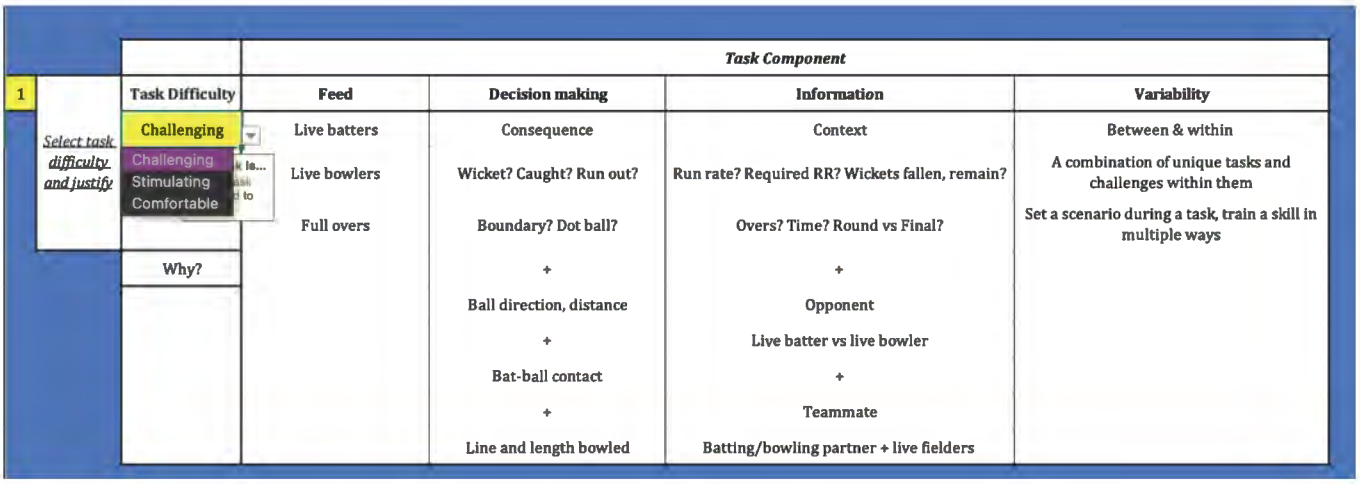
Chapter 8 Appendix

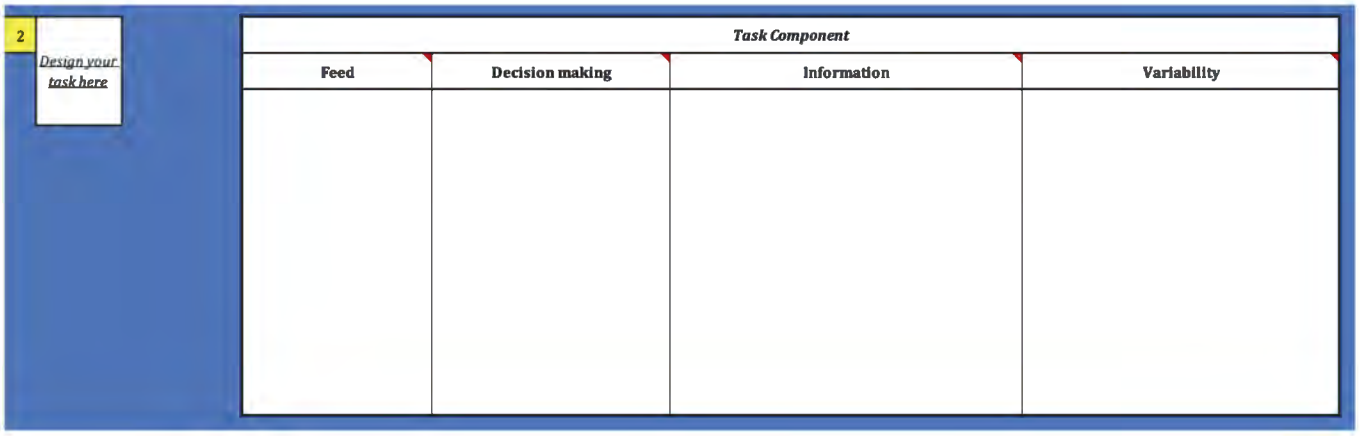
8.1 Appendix 1

Step 1: Select task difficulty and write justification



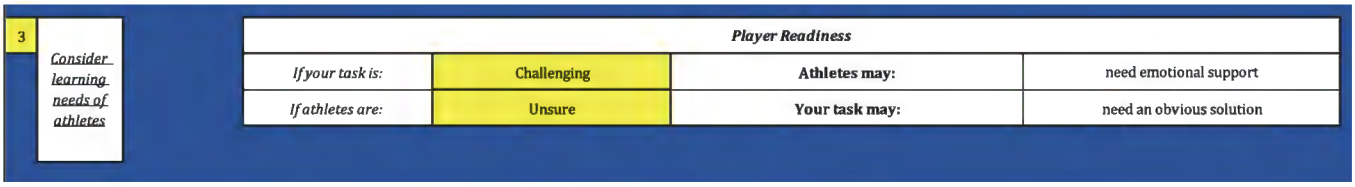
1		Task Component			
	Task Difficulty	Feed	Decision making	Information	Variability
Select task difficulty and justify	Challenging (Challenging / Stimulating / Comfortable)	Live batters	Consequence	Context	Between & within
		Live bowlers	Wicket? Caught? Run out?	Run rate? Required RR? Wickets fallen, remain?	A combination of unique tasks and challenges within them
		Full overs	Boundary? Dot ball?	Overs? Time? Round vs Final?	Set a scenario during a task, train a skill in multiple ways
	Why?		+	+	
			Ball direction, distance	Opponent	
			+	Live batter vs live bowler	
			Bat-ball contact	+	
			+	Teammate	
			Line and length bowled	Batting/bowling partner + live fielders	

Step 2: Design the task by including the task components above.



2	Task Component			
Design your task here	Feed	Decision making	Information	Variability

Step 3: Factor in task difficulty and emotional response into task design.



3	Player Readiness			
Consider learning needs of athletes	*If your task is:*	Challenging	Athletes may:	need emotional support
	If athletes are:	Unsure	Your task may:	need an obvious solution