

**Understanding tactical behaviour in netball: Investigating
the interpersonal dynamics of turnovers.**

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Abstract

Understanding tactical behaviour in invasion sports has historically been limited by reductionist approaches that pay little attention to the complex interactions that occur within the performance context. For example, much of the published research has focused on 1v1 dyadic relationships such as those between the ball carrier and their immediate opponent. In an attempt to understand tactical behaviour in a more holistic manner, recent research trends have adopted ecological, systematic approaches. These approaches capture the importance of the relationship between the individual and their wider performance environment. At present, there still remains a lack of research specifically looking at tactical behaviour in netball.

As a sport, netball offers a unique context to explore tactical behaviour due to the various rule-based constraints placed on the athletes. For example, when a netball player is in possession of the ball they cannot move (more than one step), and they must pass the ball within three seconds of receiving it. In addition, defensive players are restricted by the obstruction and contact rules which dictate how players are able to gain possession of the ball. As a result, the tactical behaviours that netballers use to reach performance goals (i.e., maintain possession and score on attack, or create turnovers and prevent scoring on defence) require strong interpersonal relationships.

This thesis is comprised of three empirical studies which have been developed to better define, identify and assess tactical behaviour in netball. The first study (chapter four), adopted the Delphi method to capture expert coach knowledge and create a well-defined, concise list of tactical behaviour definitions specific to netball. The Delphi method consisted of three rounds of data collection, which began with interviewing twelve expert coaches to answer the question; why do turnovers occur in netball? The coaches' responses were thematically analysed and developed into a preliminary list of tactical behaviour definitions. In the subsequent rounds of data collection, the coaches rated their agreement to the definitions, and were able to provide amendments if necessary. As a result, a list of 18 tactical behaviour definitions were developed to form the Tactical Principles Guideline (TPG). Interestingly, the majority of the tactical behaviours identified by the coaches could be considered as 'off-

the-ball' behaviours such as; protecting space and decisive movement on attack, as well as confusing space and dictating movement on defence.

The second study (chapter five), was conducted to further validate the tactical behaviours within the TPG. This validation process was conducted to ensure that a different group of coaches were able to identify the tactical behaviours in a variety of turnover scenarios. In this study, a group of coaches were instructed to use the TPG to identify the different tactical behaviours they observed, as well as identifying which players were involved in creating and causing the turnovers. The results highlighted that all of the tactical behaviours were considered identifiable, meaning that the TPG can be used to explain why turnovers occur in netball. In addition, the tactical behaviours that were most frequently identified were behaviours that occur off-the-ball, such as; options to the ball, decisive movement, dictate movement, and defensive unity. The coaches also identified an average of 4.86 defensive players involved in creating each turnover, and an average of 3.96 attacking players involved in causing each turnover. These findings emphasise the vital role that 'off-ball' players have in creating and causing turnovers in netball.

The final study in chapter six was conducted to test the applicability of the TPG in a real context for team selection. During a development camp, a group of coaches and selectors used the TPG to rate 49 athletes. These ratings were analysed to determine if the coaches and selectors ratings were able to distinguish between the athletes who were selected and those who were not selected into a national squad. The results suggest that the selectors ratings could distinguish between selected and non-selected athletes, however, the coaches ratings could not. A justification behind the differences between selectors and coaches is potentially due to the different underlying purpose for the rating task. For the selectors, the ratings were conducted to aid in their team selections, however for the coaches, the assessments were conducted to provide the athletes with feedback about their future development. Therefore, as team selection requires positions (shooters, mid-courtiers and defenders) to be filled, it is not necessarily the 'best' players (who would theoretically have the highest ratings) that get selected.

In summary, an important outcome of the research in this thesis, was the identification of the key tactical behaviours that are used to create or cause turnovers in netball. In particular the emphasis placed on off-the-ball behaviours contributed new and novel research to capture a holistic understanding of tactical behaviour in netball. This research has produced a guideline for defining, identifying and assessing tactical behaviour in netball which is theory-based and practically endorsed by those coaches and selectors who have had experience with using the TPG.

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Attestation of Authorship

I hereby declare that this submission is my own work and that to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Alana Coombe

08/11/19

Co-Authored Works

The current thesis contains jointly authored articles submitted to peer-reviewed journals (chapters four, five and six).

Chapter Four: Coombe, A., Millar, S.K., Button, C., Oldham, A. Defining tactical competency during turnovers in Netball: Using the Delphi method to capture expert coach knowledge. Accepted by the Journal of Sport and Exercise Science.

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Chapter Six: Coombe, A., Millar, S.K., Button, C. Investigating the predictive value of the Tactical Principles Guideline (TPG) during squad selection in netball.

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Ethics Approval

Ethics approval to conduct this research was granted by the Auckland University of Technology Ethics Committee (AUTEK).

- Study one (16/436): Accepted 18/11/16 (Appendix A); amended and accepted: 14/09/17 (Appendix B)
- Study two (18/279): Accepted 18/07/18 (Appendix G)
- Study three (18/279): Amended and accepted 14/11/18 (Appendix J)

Glossary

Attack/Attacking:	A team is on attack, or on the attacking team, when one of the players on their team is in possession of the ball.
Breaking (at the centre pass):	After each goal is scored, play is re-started with a centre pass. All players must be in their starting position and cannot step over the line into the centre third before the umpire's whistle is blown.
Contact	The 'contact rule' in netball means that both attacking and defensive players cannot come into contact with an opposition player in a way that interferes with their play.
Defence/Defending:	A team is on defence, or is the defending team, when they are not in possession of the ball.
Free:	When a player is free this means they are unmarked by a defensive player and open to receive a pass from a teammate.
Held Ball (three second rule):	The player in possession of the ball cannot hold the ball for longer than three seconds.
Incorrect throw-in:	A throw-in is a method of re-starting play after the ball has gone out of bounds. In netball there are many faults that can indicate an incorrect throw-in, such as being on, or too far back from the boundary lines of the court.
Mark:	Players can 'mark' opposition players, which means they are defending them. This can involve standing or moving around the court with them.
Obstruction:	A player may not defend (with their arms outside of their natural stance) if they are within 0.9m of another player.
Offside:	Each playing position has restrictions for where they can move on court. A player is penalised as being offside if they enter into a court space they are not permitted.
Partner:	In netball, there are seven positions, that are paired with an opposition partner; GS and GK, GA and GD, WA and WD, C and C. Players do not have to mark their partner throughout the game.

- Turnover:** Turnovers occur when the ball changes possession from one team to another team. There are various ways that the ball can change possession. Turnovers are explained further in chapter one.
- Zone:** A zone defence occurs when the defensive team marks space, rather than directly marking a player.

Chapter 1 Introduction

1.1 General introduction: Why do turnovers occur in netball?

The 2019 Netball World Cup final (Liverpool, UK) resulted in the New Zealand Silver Ferns beating the Australian Diamonds by one goal. Small margins like this are not uncommon in netball; in fact, over the last seven Netball World Cup finals, there was an average goal differential of only two goals. These results highlight that in elite netball every moment matters, and one turnover (change in ball possession between teams) can be the difference between winning and losing.

In the data rich world of sports analytics, one can easily determine what contributes to turnovers through the quantification of measurable performance attributes (Hutchins, 2016). However, identifying why the turnover happened is too often neglected. For the purpose of this Ph.D., understanding why, is conflated with the concept of tactics, which are often viewed as abstract, high level, and perhaps difficult to deconstruct and define. As such, the purpose of the thesis, is to define, identify and assess the tactical behaviours that create or cause turnovers in netball. In this introductory chapter, background information will be provided to highlight the current context in which this research was conducted, as well as the overarching research rationale, research questions and structure of the thesis.

1.2 Background

Within team sport literature, an understanding of successful performance has historically been limited by individualised, reductionist approaches with little reference to the complex interactions occurring within a performance context (Travassos, Araujo, & Esteves, 2013). For example, individualised, reductionist approaches such as notational analysis, have typically been used to explore tactical behaviour in team invasion sports (Alexander, Spencer, Mara, & Robertson, 2019). Notational analysis is a type of performance analysis where performance metrics, referred to as 'indicators', are used to describe different patterns of behaviour (Bourbousson, Deschamps, & Travassos, 2014). These indicators define an aspect of performance, which should provide a valid means of interpreting and understanding successful game behaviour (Hughes & Bartlett, 2002). While notational methods have been valuable for describing team tendencies or patterns of play, they have been criticised for their inability to

explain performance behaviours with reference to the wider performance context (Travassos et al., 2013; Vilar, Araújo, Davids, & Travassos, 2012b). For example, notational approaches typically focus on the player in possession of the ball (what they did wrong) and the player who gained possession of the ball (what they did well), ignoring the other contextual factors, such as other team members or opposition players away from the ball (Correia, Araujo, Vilar, & Davids, 2013). In this way, when performance indicators are measured in isolation the complex behaviours that emerge when individuals interact cannot be accurately accounted for (McGarry, 2009). Therefore, notational analysis can only capture what happened, without explaining why it happened (Stein et al., 2017).

1.3 Theoretical foundation: Ecological dynamics

In order to explore the complex interactions occurring in team sport to provide meaningful explanations for why particular behaviours occur, researchers have suggested that a sound theoretical rationale should be used (Glazier, 2010). Within the literature, ideas from the ecological dynamics perspective have been advocated as a suitable theoretical foundation for understanding team sport (Vilar, Araujo, Davids, & Button, 2012a). The ecological dynamics approach seeks to understand behaviour on an ecological scale, where the relationship between the individual and their environment is key to understanding the 'why' behind certain behaviours. In particular, ecological dynamics stresses the importance of the interactions between individuals within their performance context, and how these interactions shape emergent behaviour in team sport (Glazier, 2010). The ecological dynamics approach combines key concepts from many relevant disciplines such as dynamic systems and ecological psychology (Araujo, Davids, & Hristovski, 2006) to explain coordination and control processes in human movement (Seifert, Komar, Araujo, & Davids, 2016). There is a huge variety in the terminology used to explain the key concepts within ecological dynamics. For the purpose of this thesis, three commonly used concepts used to explore ecological dynamics will be focused on, including; complex systems, self-organisation and affordances, which are explained below.

The first concept is the idea that sports teams are best understood as complex adaptive systems (Passos, Araujo, & Davids, 2013), made up of many interacting parts (or degrees of freedom), capable of affecting other parts in the system (Davids, Button,

& Bennett, 2008). In complex systems, such as team sports, the players within a team can be considered as independent parts with multiple degrees of freedom, that are coupled with each other in different ways. For example, inter-couplings describe the relationship between an attacker and a defender on opposing teams, where their interactions change depending on the changing state of the game (Stöckl, Plück, & Lames, 2017). A key component of complex systems, is that the many interacting parts can self-organise to produce coordinated behaviour (Davids et al., 2014). Self-organisation (the second concept focused on in this research), refers to the fact that the flow of the game is not controlled by an external force (such as coach instruction); rather, it emerges from the ongoing interactions between players within their performance context (Davids, Araujo, Vilar, Renshaw, & Pinder, 2013). The third important concept to consider is the idea of affordances, which is part of a wider understanding of perception and action. The concept of affordances relates to 'opportunities for action'; that is, the role of information in the coordination of behaviour, where a player's actions within the sporting context are regulated by the information available in the environment (Seifert, Araujo, Komar, & Davids, 2017).

The ecological dynamics approach proposes that the relationship between perception and action is direct and reciprocal, and can be used to understand tactical behaviour in team sport (Vilar et al., 2012a). Direct perception means that the information in the environment can be directly perceived and acted upon. For example, when a defensive player sees an attacking player approaching, they are able to perceive the positioning and velocity of that player and respond based on what they see. This direct relationship between perception and action is in contrast to accounts of indirect perception where environmental information is perceived and then integrated with existing knowledge, so that an appropriate decision can be selected and executed (Broadbent, Causer, Williams, & Ford, 2014). This 'indirect process' suggests that environmental information is 'meaningless' and can only be made sense of when it is referenced to existing internal representations such as memories and past events (Davids et al., 2008). Indirect perception infers a process that is not well suited to the high-paced, constantly changing, dynamic environment of team sport, as the time required to integrate information with an internalised representation places a huge burden on cognitive processing (Chow, Davids, Button, & Renshaw, 2016). Therefore,

for this research, the ecological dynamics approach and the idea of direct perception are incorporated into an understanding of tactical behaviour (Gesbert, Durny, & Hauw, 2017). When considering behaviour from an ecological dynamics perspective, one must understand that behaviour emerges from performer-environment interactions and this behaviour is dependent on the perception of affordances (Araújo, Hristovski, Seifert, Carvalho, & Davids, 2019). In this way, an athletes' knowledge of the performance environment, and their ability to decipher the irregularities within it, enables the identification of cues that invite, offer or demand action (Seifert et al., 2016).

At an interpersonal level, players can be perceptually attuned to affordances for, and of, others. Perceptual attunement refers to a player's ability to perceive affordances *for* others, which requires an athlete to accurately assess what actions are possible for a teammate or opposition player. For example, when passing the ball to a teammate, the pass must be placed within reach of their teammate but out of reach for a defensive player. Perceiving affordances *of* others is different and refers to the ability to act upon the opportunities others have created for you (Fajen, Riley, & Turvey, 2008). For example, in basketball a player may set a screen to afford another player the opportunity to move away from a defender.

The recognition of an opportunity to act by a player does not necessarily afford the same action for every individual, as specific constraints can influence what is possible in a given situation. For example, different individuals will have different physical constraints, such as their height, that restrict what is possible for them to achieve. Therefore, an affordance can be thought of as a relational property specific to the individual and their movement/skill capabilities (Chemero, 2003). This highlights the close link that exists between technical and tactical competence, as the ability to perceive or create an affordance for another player, depends on both players' technical abilities to act on and execute the required action (Bruce, Farrow, Raynor, & Mann, 2012b).

Opportunities to act are also influenced by various constraints on the system, which originate from three sources; the organism, their environment and the task at hand (Newell, 1986). Organismic constraints are those that relate to the individual athlete, including their age, body mass, height, fatigue and anxiety levels (Davids et al.,

2008). Environmental constraints are the various factors that are external to the individual, such as the weather, pressure from the crowd or the relative positioning of defenders (Davids et al., 2008). Finally, task constraints are specific to the task at hand such as scoring goals and gaining turnovers (Glazier, 2010). These three sources of constraint can be either physical or informational. Physical constraints can be structural constraints such as the size of a player's hands, or functional constraints such as one's perceptual abilities (Davids et al., 2008). In contrast, informational constraints refer to the information that is available through different forms of energy; that is, an optic flow of energy provides visual information, such as movements or objects that can constrain action (Travassos et al., 2012). Further exploration of the different constraints on performance will be discussed in the literature review chapter.

There has been some debate whether behaviours that require deliberation or intent include cognitive processes that are not well captured within an ecological dynamics approach (Button, Seifert, Chow, Araujo, & Davids, 2020). However, it is a common misconception that ecological dynamics does not recognise elements of cognition outside of direct perception (Button et al., 2020). For example, while (Gibson, 1986) most notably wrote about the role of 'knowledge of' the environment (i.e., perception of affordances), he also wrote about the role of 'knowledge about' the environment. Knowledge about the environment is acquired through communication, feedback and learning, and can be used to inform action (Button et al., 2020). While a cognitivist researcher would assume that this type of knowledge lives internally within the mind of an individual, ecological dynamics proposes that cognition is embodied and emerges based on constraints in the performance environment (Araújo et al., 2019).

From an ecological dynamics perspective, past knowledge can be considered as a form of informational constraint that can bind players to a particular tactical action (Passos et al., 2013). Through learning and practicing under particular constraints, a team becomes perceptually attuned to the affordances that are created under these constraints. For example, a team may develop set-plays for a 'throw-in', which is practiced, so the team knows what to do during a throw-in. Regardless of the prior planning developed in training (i.e. knowing where to stand and what to do during the throw-in), every moment of a game demands an ongoing and continuous adaptation to what's happening in the performance environment (Passos et al., 2013). It is this

adaptation to the environment which is considered as tactical behaviour, and the focus of this thesis.

It should be noted that while ecological dynamics was chosen to inform this research, to define and understand tactical behaviour, it is recognised that there are times in a game where players have time to stop, watch, plan and reflect on their past knowledge which may be more indicative of a top-down cognitive approach. While ecological dynamics may not be the best framework to explore this type of cognition, this thesis is focussed on time sensitive and reactionary behaviour, and thus well suited to an ecological dynamics approach.

1.4 Invasion sports

There are a myriad of sport disciplines all over the world that are primarily categorised as team or individual sports. Arguably, the largest category of team sports are invasion sports, where teams 'invade' their opponent's territory to score points (Elferink-Gemser et al., 2010). In invasion sports, such as basketball, rugby, football, hockey and netball, players make decisions and execute skills in attacking, defensive and transition phases (Serra-Olivares, Clemente, & Gonzalez-Villora, 2016a). During attacking phases, the team in possession of the ball attempts to maintain possession and create scoring opportunities, while the team on defence tries to impede progression and prevent scoring opportunities to regain possession (Hughes & Bartlett, 2002).

A primary challenge in invasion sports, unique from other team sports, is the intensity of the opposition relationship (Gréhaigne, Richard, & Griffin, 2005). The intensity of the opposition relationship refers to the fact that in invasion sports, opposition teams are directly competing for ball possession in the same space. This can be contrasted to striking/fielding sports such as cricket and baseball, or net/wall sports like volleyball, as these sports strictly separate the teams through either an innings (one team is batting, while the other team is bowling, pitching or fielding), or separating teams with a physical barrier like a net (Mitchell, 1996). As a result, team invasion sports have an inherent complexity associated with them; thereby, offering a unique context to explore the interconnectivity of team behaviour and its relationship to successful performance.

1.5 The sport of netball

Netball is a team invasion sport and the number one female sport in New Zealand, currently with over 140,000 registered players (Netball New Zealand, 2019a). Globally, netball is played by more than 20 million people in 80 countries (INF, 2018). New Zealand's national women's team, the Silver Ferns, have played in all 21 of the pinnacle events in netball, including 15 Netball World Cups and six Commonwealth Games tournaments, finishing in the top three in all but one of these events (Netball New Zealand, 2019b). Despite New Zealand's successes and the increasing global popularity, netball is still conspicuous by relative absence in sport science research, which is especially noticeable in the dearth of performance analysis research targeted at the tactical domain (McClean et al., 2019).

To provide further background of the sport, netball is a fast-paced sport consisting of two teams of seven players, with an additional three to five substitutes on each team. Each of the seven on-court players have a specific position including; goal shoot (GS), goal attack (GA), wing attack (WA), centre (C), wing defense (WD), goal defence (GD) and goal keep (GK). These positions are generally categorised into shooters (GS, GA), mid-courtiers (WA, C & WD) and circle defenders (GD, GK), and each position is differentiated from the others based on their individual roles and positional restrictions. These positional restrictions are based on the three thirds of a netball court (two goal thirds and the centre third), as well as two goal circles at each end of the court, as shown in Figure 1 below. The two 'shooters' on each team (GS & GA) are the only two players who are allowed to score points, and their direct opponents or 'partners' (GK & GD) are the only two players who are allowed in the goal circle to stop them.

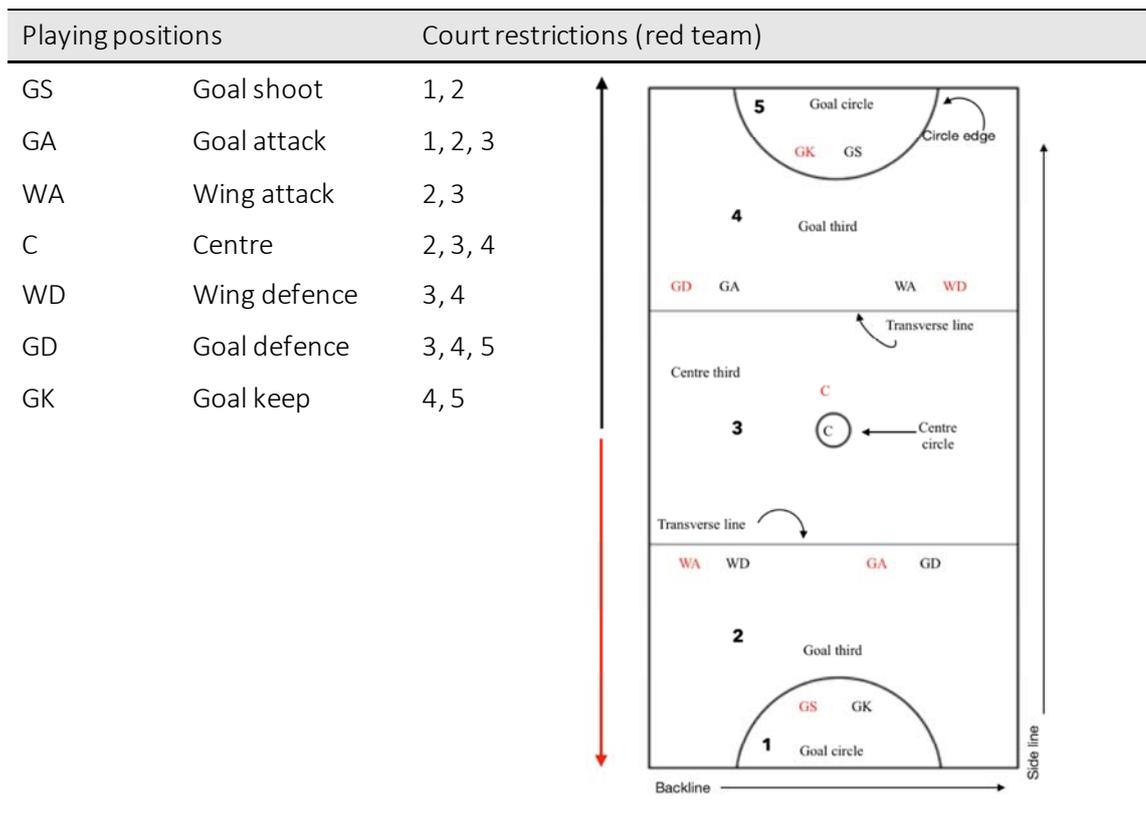


Figure 1: Playing positions and court restrictions in netball (for the red team).

The primary objective of netball is to outscore the opposition team within a 60 minute match (consisting of four, 15 minute quarters). The team in possession of the ball (the attacking team), must move the ball from player to player (passing the ball with their hands) through the court, into the goal circle, and score. Points are scored by throwing the ball through the hoop (atop a 10ft/3.05m goal post, without a backboard), with each successful goal worth one point. The defending team, who is not in possession of the ball, must stop the progression of the attacking team and prevent scoring.

Following each successful goal, the game is restarted by a 'centre pass', which alternates between each team regardless of who scored (Pulling, Eldridge, & Lomax, 2016). The alternating centre pass creates equal opportunity for each team to score goals throughout the game. Therefore, theoretically, if both teams were to score from all their centre passes, the most they could lose by, is one goal. However, a study conducted by O'Donoghue, Mayes, Edwards, and Garland (2008) with British Super League netball teams, indicated that teams scored from between 31% to 54% of their centre passes (depending on the level of competition they are playing against). This

statistic can be compared to the recent Constellation Cup test series between Australia and New Zealand, where the percentage of goals scored from centre passes ranged between 48% and 76% (Champion Data, 2019). While the Constellation cup data indicates a higher standard of performance compared to the British Super League, these centre pass to score percentages highlight that errors and changes in possession occur frequently and, therefore, are an important indicator of team success in netball.

1.6 Turnovers in netball

Changes of possession or turnovers in netball are well documented through notational analysis (O'Donoghue et al., 2008). In netball, turnovers can be organised into two main categories; losses or gains. A loss occurs when the ball is 'lost' by an attacking team due to their own error, which may have come about due to the defensive pressure exerted by the opposition. In notational analysis, a loss is traditionally coded as an opposition error (OE) and can be further categorised as a passing error, a receiving error, stepping¹, an offensive penalty or as 'other', which includes errors such as a held ball, offside, incorrect throw-in, or breaking at the centre pass (definitions of these errors can be found in the glossary on page xiv). In contrast, a gain occurs when the defending team gains possession of the ball either through a tip², intercept or rebound. For further clarification of the rules, refer to the international netball rules available on the international netball federation webpage (INF, 2016).

An example of the notational methods used in netball are highlighted in the sequence of play shown in Table 1 below. In this example, the first row shows that a centre pass (CP) is taken by team one, followed by a sequence of passes until the GD makes a passing error (PASS). In the second row, we can see that the passing error results in the GA from team two tipping the ball (TIP) and gaining possession, passing the ball to the WA, and eventually leading to the GS scoring.

¹ Players are penalised for 'stepping' when move more than one step while in possession of the ball.

² Tipping in netball is an action performed by a player to 'tip' or hit the ball with their hand, preferably to a teammate, or themselves.

Table 1: Example of a sequence of play resulting in a turnover

Team 1	CP	C	WA	GD	WA	C	GD	PASS	
Team 2	TIP	GA	WA	GS	WA	GD	C	GS	SCORE

The example in Table 1 above, highlights how the gain (TIP) achieved by the GA is a direct result of the passing error of the GD. However, it is important to note that not all losses (passing errors) have an opposition gain associated with them. For example, in Table 2 below the GD was penalised for a held ball (HELD), meaning that the GD was in possession of the ball for more than three seconds. As team one was penalised by the umpire for the held ball, team two was awarded possession of the ball, which is coded as an opposition error (OE). The OE indicates that the turnover was due to the actions of the GD (who did not pass the ball within the legal time frame), suggesting that the turnover was not caused by any direct action from the defensive team (team two).

Table 2: Example of a loss in netball

Team 1	CP	C	WA	GD	HELD					
Team 2	OE	WD	GD	C	WA	WD	WA	GA	WAF	GA

Notational methods of analysis become problematic in these contexts (as demonstrated in Table 1 and Table 2) as they do not capture the potential role of other players who may have caused or created the turnover. For example, the scenario in Table 2 does not capture the actions of the defensive team who may have created the held ball through their defensive pressure, leaving the GD with no options to pass to and thus forcing the held ball. Likewise, notational methods do not capture the actions of the other attacking players who may have failed to make themselves viable passing options for the GD. Therefore, turnovers in netball are poorly understood, as notational methods often fail to explain why turnovers occur. Notational methods have dominated the literature on tactical performance over the past couple of decades (Hughes & Franks, 2004); however, questions have been raised over the suitability of these notational methods for capturing tactical behaviour in team in sports (Lemmink & Frencken, 2013). This issue will be discussed further in the literature review chapter, when the definitions of tactical behaviour are reviewed. For now, it is important to

highlight how Netball New Zealand were defining tactical behaviour prior to the commencement of this Ph.D.

1.7 Netball New Zealand's current methods for defining tactical competency: The Player Profile

The Netball New Zealand Player Profile (NNZPP) was developed as a means to benchmark the competencies that are believed to be integral for developing world class Silver Ferns. The player profile is underpinned by four competencies including; physical, technical, tactical and Hauora³. Players who are identified as 'talented' are recruited into player development pathways. This recruitment processes typically occurs when various selectors or talent scouts observe players competing at club or school netball tournaments. Athletes are then invited into development programmes that are delivered through their netball zone (there are five netball zones in New Zealand; South, Mainland, Central, WAIBOP and Northern), or by Netball New Zealand. The player profile is then used by coaches and selectors to rate individual players in the four competencies. When looking specifically at the tactical component of the NNZPP, there are three categories of tactical competency; decision making, reading play and court presence. Within the player profile, these three tactical competencies are clarified further, as shown in Table 3.

Table 3: Tactical competencies in the Netball New Zealand player profile

Tactical competencies	Definitions
Decision making	Shot selection, options, accurate ball under pressure/fatigue/critical moments.
Reading play	Vision, space awareness, anticipation.
Court presence	Deception, working together with unit, communication.

The three categories of tactical competency in the player profile highlight important aspects of tactical behaviour that have been referenced in the literature (Bruce et al., 2012b; Farrow, 2010; Farrow & Abernethy, 2002). However, the competencies are relatively vague and do not offer further exploration of their meanings within a netball context. For example, the reading play competency includes 'space awareness', but what is space awareness in a netball context, and what does it

³ Hauora is a Māori concept, encompassing a holistic view of health and well-being.

look like when performed well? With ill-defined competencies, coaches may interpret them differently, leading to inconsistencies in player ratings and feedback. For example, two coaches could observe one player and have very different ratings, as they may have been focussing on different aspects of behaviour. When feedback is given to a player, it is possible they will receive inconsistent messages, which is not conducive to player development. Given the limitations of the NNZPP, Netball New Zealand recognised the need for more research to be conducted in this space.

1.8 Thesis rationale

The lack of netball specific tactical definitions in the player profile was recognised by Netball New Zealand as an important gap in knowledge that needed to be filled. As a result, a research opportunity (this current Ph.D) was created. While the specifics of the research question were left open, Netball New Zealand were interested in creating netball specific knowledge to supplement the tactical competencies in the player profile. As such, this thesis seeks to better understand and define tactical competency in netball; with the intention of applying this knowledge to developing the Netball New Zealand player profile.

1.9 Research questions and objectives

The overarching research question of this thesis is: Understanding tactical behaviour: why do turnovers occur in netball? Within this overarching question, four specific research questions were asked including;

- 1) Study one, chapter four: What are the key tactical behaviours related to turnovers in netball?
- 2) Study two, chapter five: Are the tactical behaviours in the Tactical Principles Guideline identifiable?
- 3) Study two, chapter five: Can the tactical behaviours in the Tactical Principles Guideline be used to determine why turnovers occur in netball?
- 4) Study three, chapter six: Can the Tactical Principles Guideline be used to differentiate between selected and non-selected youth netballers?

1.10 Thesis structure

This thesis consists of a combination of discrete journal articles (chapters four, five and six), and comprehensive chapters (chapters one, two, three, seven and eight). The author contributions and status of the papers acceptance can be found on page xi. It should be noted that the journal articles are presented as stand-alone chapters and, as such, may include inevitable repetition of information throughout the thesis; especially from the literature review, discussion and conclusion chapters. The thesis structure is highlighted in Figure 2 below.

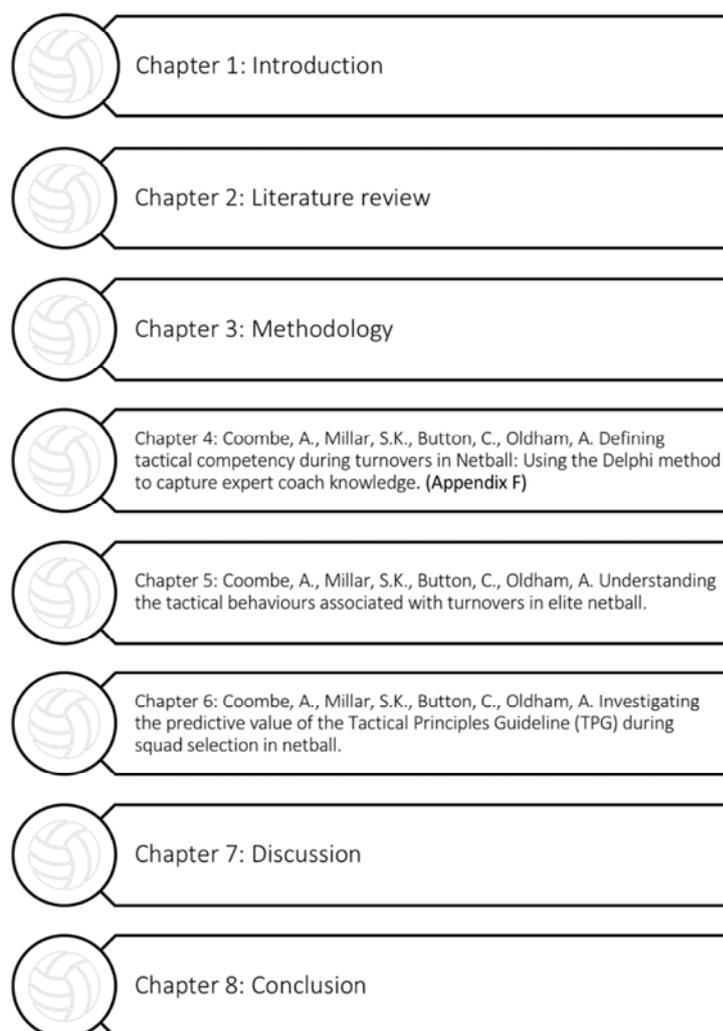


Figure 2: Overview of thesis structure

Following this introductory chapter, a comprehensive literature review is provided in chapter two, critiquing the extant literature focused on defining and assessing tactical behaviour in team sport. In chapter three, the research paradigm and

methodology underpinning the research is explained. Three empirical studies then follow in chapters four, five and six. Chapter four was concerned with creating a set of tactical behaviour definitions and overarching tactical principles to define tactical competency in netball. In chapter five, video analysis was used to identify the tactical behaviours in turnover scenarios. In chapter six, the tactical principles identified in chapter four were used to determine if selected and non-selected players could be differentiated based on subjective scores. In the final chapters (chapter seven and eight) an overall discussion and conclusion is provided to summarise the most important findings, limitations, practical implications, and future research directions.

1.11 The role of Appendix F and its contribution to the thesis

In Figure 2 above, Appendix F is included as an addition to chapter four. As chapter four was submitted as a manuscript, the Appendix was not originally included. Appendix F includes quotes from the expert coaches, collected in the first round of data collection. The raw interview transcripts were analysed using thematic analysis to identify themes, which were then used to define a variety of tactical behaviours to create the Tactical Principles Guideline (TPG). The information from this initial round of data collected is considered valuable to the thesis as it provides an in-depth understanding of how the tactical behaviours in the TPG came to be included. Therefore, Appendix F should be read as supplementary information to the study in chapter four.

Chapter 2 Literature review: Definitions of tactical behaviour in team sport

2.1 Preface

In order to understand the tactical domain in team sport, it is important to grasp the multiple ways in which tactical behaviour has been defined and assessed within the scientific literature. This chapter is constructed as a narrative review of the varied definitions and methods used to assess tactical behaviour, generally, across team invasion sports. The narrative review will be followed by a more in-depth critical review of the netball specific studies that have been conducted looking at tactical competency.

2.2 Defining tactical behaviour in team sport

Within team sport, the overarching objective is to score more points than the opposition team to win the game. Grehaigne, Godbout, and Bouthier (1999) suggested that each sport has an internal logic, derived from its laws and rules, that governs how the overarching objective can be reached. The laws or rules of a sport characterise how teams can score, how and where players can move, and how players are allowed to engage with each other (Gréhaigne et al., 2005). For instance, in rugby union a governing rule is that players are allowed to kick the ball forward, but can only pass the ball backwards. This is in contrast to similar invasion sports such as American football or Australian Football where the ball can be passed forward toward the opposition teams goal line or goal posts. With these different rules, athletes must come up with inventive and unpredictable ways of overcoming the opposition team in order to score. In this way, the internal logic of a game informs how strategic and tactical behaviours are applied.

Strategy and tactics are two terms that are often used interchangeably to describe the intent behind decision making; however, a useful distinction can be made between them based on their temporal relationship to action (Grehaigne et al., 1999). Strategy refers to the decisions made prior to the game, which inform how a team intends to overcome their opposition. Strategies are thus the macro-level plans (game plans, set-plays or team structures), developed and refined by coaches and athletes outside of competition (i.e., before the game, during training) (Gréhaigne et al., 2005). In this way, strategies have temporal separation between their conception and

subsequent action (Light, Harvey, & Mouchet, 2014). In contrast, tactics or tactical behaviour emerge from the on-going, complex interactions occurring in the performance environment, where decisions are made at the point of action (Light et al., 2014). With this distinction in mind, a preplanned strategy can be thought of as a plan for how a team intends to overcome an opposition, which can inform in-game decisions (e.g., the decision to use a strategy to target an opposition weakness). However, the implementation of the strategy will only be successful when it is applied with reference to the performance context, as players must adapt and react to what the opposition are doing in each moment. It is this adaptive and reactionary behaviour that is considered 'tactical' as players intentionally perform the most effective solution for a given problem in a specific context (Araújo et al., 2019).

Within complex dynamic systems, such as team sport, opposition teams generate unexpected behaviours that must be constantly adapted to (Correia et al., 2016). The actions performed to respond and adapt to the momentary changes in the performance environment are what separates a tactical behaviour from a general technical skill (Evertsz, Thangarajah, Yadav, & Ly, 2015). A general technical skill refers to any movement competency such as jumping, landing and turning fully, or a ball skill such as delivering accurate ball, and catching. For example, a general technical skill such as passing the ball, would not be defined as a tactic. However, a pass that is made in response to a specific game configuration with the intention to overcome it, would be considered tactical (Gutierrez, Villora, Lopez, & Mitchell, 2011). As both teams are constantly responding and reacting to each other's behaviour, the opposition relationship creates a high level of unpredictability and uncertainty, meaning that players are never certain who is going to do what, at any specific moment (Passos, Araujo, Davids, & Shuttleworth, 2008). As a result, the system fluctuates between states of stability and instability. A stable state of coordination occurs when the system is resistant to the task constraints that might perturb the stability of the system (Araujo, Davids, Bennett, Button, & Chapman, 2004). In team sport, the system is considered stable when any movement by an attacking player (in an attempt to get free) is counteracted by a defender, meaning that the attacking team is unable to create scoring opportunities (Passos et al., 2008). For example, if one team is re-starting play

with a 'throw in'⁴, the system is considered stable if all the attacking players' movements (to become available to receive a pass) are fully compensated for, or reacted to, by the defensive team (Hristovski, Balague, & Schollhorn, 2014). Eventually, when an attacking player gets free to receive the inbound pass, they are momentarily breaking the stability of the system (i.e., creating a perturbation), until the system settles into a new state of stability (Kim, James, Parmar, Ali, & Vučković, 2019). When the system is transitioning between states of stability and instability, this is when the system is most vulnerable to one team scoring. In a football study, it was shown that if teams are slower to transition from attack to defense, they are slower to regain the stability of the system, they are more likely to concede a goal (Shafizadeh, Gray, Sproule, & McMorris, 2017). These transitional periods of play between attack and defence have been referred to as perturbations, which occur when there is an incident that changes the typical flow of the game, changing the state of the system from stable to unstable (McGarry, Anderson, Wallace, Hughes, & Franks, 2002).

In a recent study, Barkell, O'Connor, and Cotton (2017), sought to define and identify the frequently occurring perturbations in Rugby 7's. Following an analysis of both men's and women's games from a Rugby 7's world series tournament (held in 2014), 13 types of perturbation were identified. The most common perturbation type for both men and women was 'evasive footwork', which is an attacking maneuver (such as a 'side-step') used to evade a defensive player's tackle. Like evasive footwork, the other perturbation types that were identified almost exclusively described the actions of individual attacking players, such as using a wide pass, a quick tap, a 'pick-and-go' or a kick to perturb the system (Barkell et al., 2017). Figure 3 below (on page 18) provides a visual example of how perturbation factors can break the stability of the system, such as in rugby 7's.

The image on the left side of Figure 3 below, shows a stable system, where the attacking team (shown by the X symbols) passes the ball (orange diamond) from player one to player four. Each time the ball is passed to a new player, that player runs forward towards a defender (the black circles) in an attempt to 'break the line'. The ball is either

⁴ A throw-in is a method of re-starting play after the ball has gone out of bounds. Each sport has specific rules around how to conduct a throw-in.

passed left to the next player or the ball carrier is tackled and the process repeats. In this scenario, the attempt to break the line of the defence is unsuccessful as the defensive team is able to make adjustments, moving to the left to stop each player, thus maintaining system stability (James et al., 2012).

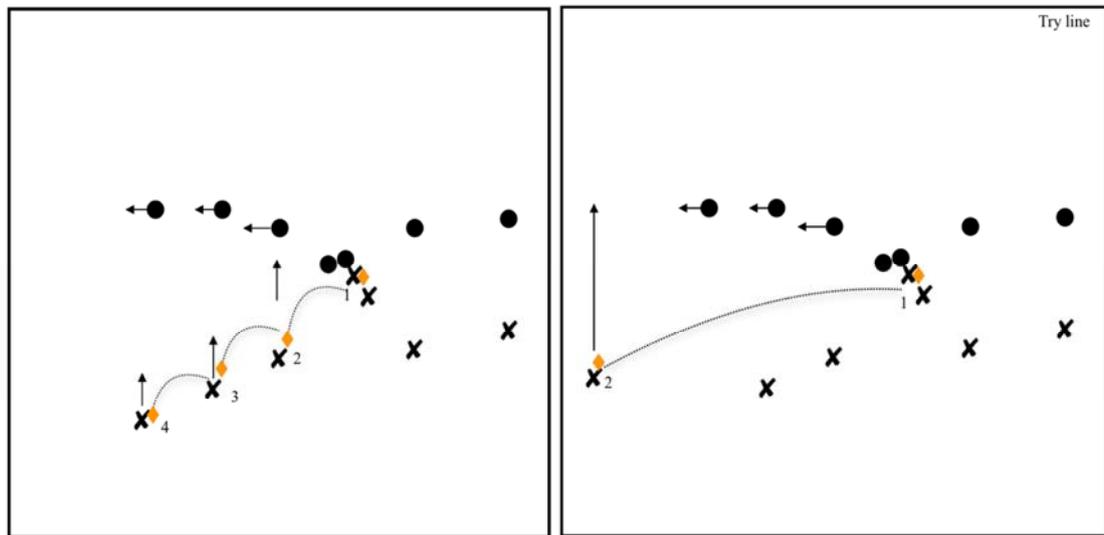


Figure 3: Example of a 'wide pass' being used as a perturbation in Rugby 7's
The left side is an example of a stable pattern, whereas the right side is an example of an unstable system. X's indicate attacking players, and black dots represent defending players.

In the second image on the right of Figure 3 above, a wide pass (as shown by the line between players 1 and 2), is used to destabilise the system. This type of pass means that the ball is passed to the widest attacking player and, as a result, the defensive team must quickly move to re-stabilise the system, or it is likely that the attacking player will be able to break the line and move into a more advantageous field position for the next phase of play, thus, capitalising on a successful perturbation (the wide pass).

In another recent study, Kim et al. (2019) sought to define the unstable situations in football that precede perturbations (i.e., goal scoring opportunities). The authors were able to identify factors such as the location of possession (penalty box possession), counterattacks, and types of passes (a successful cross) as factors that precede scoring attempts. However, the authors noted that the complexity surrounding these different unstable situations needed more explanation as there are wider contextual factors that create the conditions that allow successful behaviour to occur. For example, 'off-ball' runs by teammates, as well as the incorrect positioning of opposition players can have an effect on the eventual outcome (Kim et al., 2019).

As demonstrated by the above studies, sports research in perturbations has typically focused on incidents performed by individual players that result in successful perturbations (e.g., when a try is scored in rugby or when a goal is scored in football) (James et al., 2012). This focus on individual behaviour and successful perturbations is aligned to research conducted using a notational analysis approach. Notational analysis is a technique used for analysing performance to create a record of the events of the game (Vilar et al., 2012b). Using notational techniques, researchers utilise performance metrics referred to as 'indicators' to describe different patterns of behaviour (Bourbousson et al., 2014). A performance indicator is a behavioural variable that defines some aspect of performance, which should provide a valid means of interpreting and understanding successful game behaviour (Hughes & Bartlett, 2002). Performance indicators are typically objective, observable actions that occur 'on-the-ball' (i.e., actions performed by the player in possession of the ball or by the defending player who gained possession of the ball), such as the number of goals scored, meters gained, possession rates, errors, turnovers and penalties (Correia et al., 2013).

Notational methods provide information about who (which player) did what (the behaviour or outcome associated with that player, such as a pass, or a goal being scored), where (the particular location on the playing surface that the behaviour or outcome occurred in) and when (the instant that the action occurred) (McGarry, 2009). Therefore, notational approaches are able to capture large amounts of valuable information (who-did-what-where), to help researchers and coaches draw meaningful associations between behaviours that relate to positive outcomes (i.e., games won, and points scored) (McGarry, 2009). While notational techniques have dominated the literature on tactical performance over the past couple of decades, questions have been raised over the suitability of these methods for capturing tactical behaviour in team sports (Lemmink & Frencken, 2013). These questions are particularly relevant when considering the definition of tactical behaviour provided above (i.e., tactical behaviour is an emergent property based on the interaction between the individual and their environment). In this way, tactical behaviour is relational and context specific and, therefore, isolating one behaviour or incident (like a perturbation) performed by one player, is a reductionist approach that only captures a small part of why a behaviour occurred.

In a critical review of the performance analysis literature (in football) (Mackenzie & Cushion, 2013) suggested there is often a lack of contextual information provided by notational approaches as they tend to focus on behaviours that occur on-the-ball, and not on the relationship between players with their team mates, and opposition. This focus on on-the-ball behaviour is problematic from an ecological dynamics perspective as behaviours considered without context do not capture the complex interactions, coordination and adaptations that occur between individuals and cannot be accurately accounted for (McGarry, 2009). In this way, notational methods that focus on analysing outcome measures (performance indicators) do-not provide any information about the complex interactions of other players that can contribute to processes that create or cause turnovers (Praxedes, Moreno, Gil-Arias, Claver, & Del Villar, 2018).

The focus on individual actions in the perturbation types identified above is common within the literature, as the analysis of coordination in team sport has typically focused on discrete 1v1 attacker-defender dyads in specific sub-phases of a game (typically for the player in possession of the ball, close to scoring zones) (Headrick et al., 2012). Studies looking at 1v1 dyads highlight how the ball carrier detects and uses information and how this information affects their subsequent actions. For example, in a football study, the interpersonal distance between the defender and ball carrier was considered a key constraint that influences attacker-defender interactions (Bourbousson et al., 2014). The results from this study highlighted that when the ball carrier is close to the defender's goal, the defender will position themselves closer to the goal to protect it. However, if the player with the ball is further away from the goal, the defender will press closer to the attacking player to attempt to regain possession (Headrick et al., 2012). In a basketball example, the posture of the defender was shown to be affected by the 'drive' direction of the attacking player with the ball when the distance between the two players was small (Esteves, de Oliveira, & Araújo, 2011). The attacker moved to the side of the most advanced foot of the defender, only when there was a smaller distance between the attacker and the defender (Esteves et al., 2011). However, in team sports, behaviour must be understood outside simplistic 1v1 dyads, as player behaviour is rarely only influenced by their immediate opponent. For example, in team sports, numerous team members and opposition players can also affect decision making. More holistic, systems based methods have been adopted in recent

research (Soltanzadeh & Mooney, 2018). A central idea of systems thinking is that in order to better understand the actions of an individual, we must first consider the system as a complex whole (Soltanzadeh & Mooney, 2018).

At this point of the review, it is important to refer back to the internal logic of sport, mentioned at the start of the chapter. The internal logic of invasion sports, such as football, basketball, rugby and netball, is founded in the oppositional relationship, which has been referred to as the 'force ratio' or the 'rapport of strength' (Gréhaigne et al., 2005). The force ratio, or rapport of strength, captures the antagonistic relationship that is created when opposition teams interact (Grehaigne et al., 1999). These interactions create 'problems' that each team has to overcome. Grehaigne, Bouthier, and David (1997) identified three main categories of tactical problems in team sports including; space and time, information, and organisation, which are explored below.

1. Problems related to space and time: Space and time are key constraints in team sport. The concept of 'space' specifies where players want to perform certain actions, and time refers to the frequency of actions, or how quickly or slowly an action is performed (Rein & Memmert, 2016). In team sports, athletes have to solve problems with regard to how to create, use and defend space, as well as how to control aspects of time (Grehaigne et al., 1997).
2. Problems related to information: Information is available in the performance environment, which is detectable by players and helps aid their decision making (Araújo et al., 2019). In team sports, one of the main objectives is to manipulate the available information in order to create uncertainty for one's opposition while simultaneously creating certainty for one's own team (Serra-Olivares et al., 2016a). In this way, players can manipulate the quality of information exchanged between their teammates and opposition.
3. Problems related to organisation: Grehaigne et al. (1997) referred to the problems related to organisation as the shift from acting as an individual, to acting as part of the collective (or team). This idea is related to a systems thinking perspective, where the performance of a team is considered to be more than the sum of its parts (McLean, Salmon, Gorman, Read, & Solomon, 2017). Therefore, when players are organised to work towards collective pursuits, the team can achieve more than what could be achieved as individuals.

The three categories of tactical problems outlined above (space and time, information, and organisation), highlight the broad overarching tactical problems faced in invasion sports. Further examples of tactical problems have been identified in the literature, categorising these tactical problems more specifically into attacking and defensive problems (Mitchell, 1996; Mitchell, Oslin, & Griffin, 2013). When a team is on attack, tactical problems include how to maintain possession of the ball, attack the goal, and create and use space as they attempt to score. On defence, tactical problems include how to defend space, defend the goal and win the ball in an attempt to prevent the attacking team from scoring (Mitchell, 1996; Mitchell et al., 2013). Solving these problems is, therefore, a key component to success in team sport.

The methods used to solve these common tactical problems have been referred to as tactical principles. Tactical principles have been defined as a fundamental set of rules that help players solve the tactical problems with which they are confronted (Costa, Garganta, Greco, Mesquita, & Maia, 2011). Tactical principles link back to the logic of the game, as they inform the basic structure and organisation of a sport and can explain how and why particular decisions and behaviours are performed (Clemente, Martins, Mendes, & Figueiredo, 2014). When tactical principles are applied collectively (by multiple members of a team), the team is better able to control the game (Costa, Garganta, Greco, & Mesquita, 2009). In this way, the tactical problems identified by Mitchell (1996), such as defending space and maintaining possession, can be solved when tactical principles are incorporated into the solutions (Costa et al., 2011).

It should be noted, that the tactical principles are different (but connected) to the overarching rules of the sport that are enforced by umpires. The rules of a sport can be understood as informational variables that constrain how individuals behave (Headrick, Renshaw, Davids, Pinder, & Araújo, 2015). For example, the 'contact rule' in netball means that both attacking and defensive players cannot come into contact with an opposition player in a way that interferes with their play (INF, 2016). The contact rule is, therefore, a task constraint that creates a tactical problem for players seeking to maintain or regain possession of the ball (Mitchell, 1996). In order to solve this tactical problem, tactical principles and behaviours are used to overcome the opponent within the rules of the sport.

In the published research looking at tactical competency, there is very limited research addressing the concept of tactical principles. The literature that does exist is almost exclusively focused on association football (or soccer)⁵. Within the football literature, there have been different labels used to describe tactical principles, including general and core tactical principles (Costa et al., 2009). General tactical principles relate to both attacking and defensive stages of the game and include the general efforts made by teams to; i) avoid numerical inferiority, ii) avoid numerical equality, iii) seek numerical superiority (Costa et al., 2009). These general tactical principles suggest that when a team can create situations where they have more players involved than the opposition team (numerical superiority), they will have a tactical advantage. As an example, in basketball, a 2v1 scenario could occur, where two attacking players must contend with one defender to get into position to attempt to score. Based on the principle of numerical superiority, the attackers in a 2v1 scenario would have more tactical advantage, compared to a scenario with numerical equality between the defenders and attackers (1v1 or 2v2). However, it is important to further explore how numerical superiority can be created.

Core tactical principles build upon the general tactical principles in order to provide more specific rules for how to create numerical imbalance, as well as how to stabilise the organisation of one's own team (Costa et al., 2009). To date, the only published literature pertaining to core tactical principles, is the core tactical principles of soccer, conceptualised into the System of Tactical Assessment in Soccer (FUT-SAT) (Costa et al., 2009). The FUT-SAT comprises 10 core tactical principles including five offensive principles—penetration, offensive coverage, width and length, depth mobility, and offensive unity; as well as five defensive principles—delay, defensive coverage, balance, concentration and defensive unity⁶ (Costa et al., 2009; Costa et al., 2011). The application of these tactical principles can be observed through the actions of players (tactical behaviours), as the movements, positioning and decisions made by a team can highlight a particular tactic being used (Costa et al., 2009). The principles in the FUT-SAT

⁵ Soccer and football are used interchangeably as some authors use soccer and others use football.

⁶ See Costa et al. (2011, p. 74), for the tactical principle definitions.

are particularly relevant as, unlike past notational methods, the principles attend to behaviours that occur both 'on-and off-the-ball'.

Off-the-ball behaviours refer to the behaviours of attacking players who are not in possession of the ball, as well as defensive players not directly guarding the ball carrier (Oslin, Mitchell, & Griffin, 1998). Off-the-ball behaviours have traditionally been omitted from notational type analyses, as the video footage used to code games generally track the ball carrier and misses behaviours occurring away from the ball (Lemmink & Frencken, 2013). A number of off-the-ball behaviours have been identified in the literature to describe the actions used to solve tactical problems in team sport (Mitchell, 1996; Oslin et al., 1998). For example, attacking players who are off-the-ball can position themselves in a way that supports the ball carrier (Oslin et al., 1998). The core tactical principle 'offensive unity' is an example of a supportive behaviour used by players to position themselves to receive a pass, thus providing good quality information to the player in possession of the ball (Costa et al., 2011). Grehaigne and Godbout (1995) expanded on the 'support' concept by defining how players support the ball carrier. For example, in order to maintain possession, having a maximum number of potential receivers (options to pass to) is considered a fundamental rule to ensuring the ball carrier is supported (Grehaigne & Godbout, 1995). There are also many examples of off-the-ball behaviours that defending players use to perform tactically such as defensive unity, concentration and balance. The tactical principle in the FUT-SAT, 'defensive unity' is defined as the "positioning of off-ball defenders to reduce the effective play-space of the opponents" (Costa et al., 2011, p. 74). Therefore, off-ball defenders can restrict the space that attacking players have to use.

To summarise, Figure 4 below highlights the terminology used within the tactically focused research. To begin, the internal logic of a sport is influenced by the specific rules for each sport (Gréhaigine et al., 2005). For example, in football, there are rules around how players can gain or maintain possession of the ball. These rules create different tactical problems or constraints for teams to overcome (Mitchell, 1996). In order to solve these tactical problems (i.e., how to create or defend space), players and teams can utilise specific principles. Tactical principles represent the basic rules for how to solve tactical problems (Costa et al., 2011). For example, a team can use defensive unity to restrict the space attacking players have to use. The final term, tactical

behaviour, is the application of tactical principles through the use of observable actions. Therefore, tactical principles are the general rules, and tactical behaviours are the operationalisation of those rules (Costa et al., 2009).

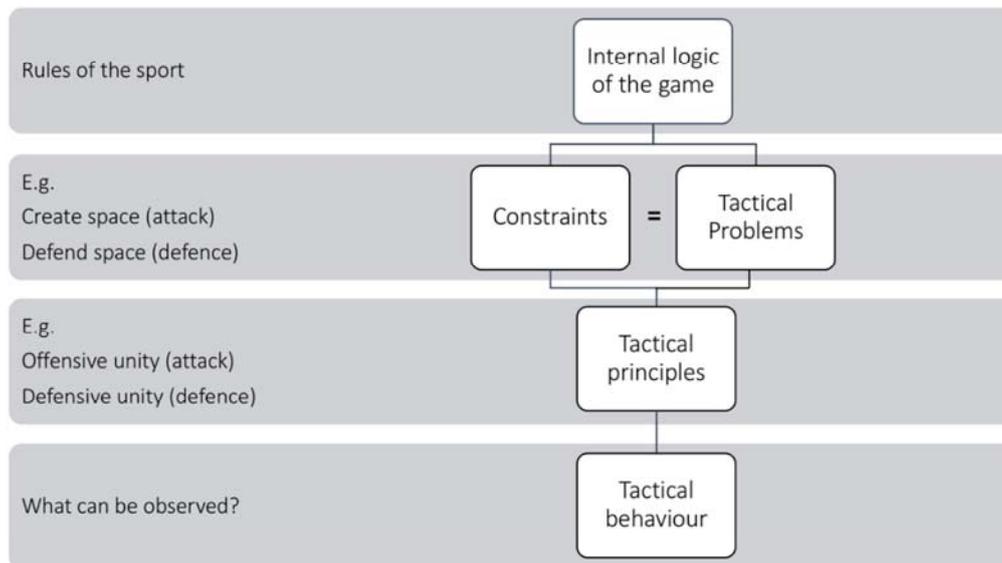


Figure 4: Terminology used to describe the tactical domain

Tactical principles and behaviours have been analysed in various studies to identify how they manifest in different contexts. In a recent study the FUT-SAT was used to compare the tactical principles adopted in 3v3 and 6v6 small-sided football games. Football games played by youth footballers (under 11) were recorded and coded to determine the frequency that each of the 10 tactical principles in the FUT-SAT were performed (Silva, Garganta, Santos, & Teoldo, 2014a). The results highlighted that the frequency of observed tactical principles changed between 3v3 and 6v6 games. The tactical principles of penetration and defensive unity were observed more frequently in 3v3 games compared to 6v6 games (Silva et al., 2014a). Presumably these behaviour changes occur as an adaptation to the different task constraints in 3v3 and 6v6 contexts. As the study conducted by (Silva et al., 2014b) did not specify how the tactical behaviours relate to performance outcomes, conclusions cannot be drawn about any associations to effective performance.

In a recent study, Rein, Raabe, and Memmert (2017) sought to determine the effectiveness of penetrative passes and their relationship to successful outcomes (goals scored) in football. A penetrative pass is one that 'outplays' a number of defensive players', meaning that the kick is able to penetrate past a line of defensive players, and

closer to the goal. When a penetrative kick or pass is used, it can destabilise the defensive team's organisation, and is thus considered a perturbation factor used to break the stability of the system. Rein et al. (2017) identified a significant positive relationship between the number of outplayed players (achieved through penetrative kicks) and the number of goals scored in a game, which increases the probability of winning the game (Rein et al., 2017). An important point to consider with these results is that a player's ability to use a penetrative kick in football, occurs within a wider context where the positioning and movements of other players impact the effectiveness of that kick. For example, when a player dribbles the ball with the intent to destabilise the defensive structure (using penetration), they are inviting reactionary responses in others both in their own team and the opposition (Grehaigne & Godbout, 1995). For example, a player's teammates may react by creating space, drawing defensive players away from the space the penetrating player wants to use. The success of the penetrative movement is, therefore, determined by the supportive actions of the other off-the-ball players. At present, there remains key questions around the specific details of how off-the-ball behaviours influence a team's ability to coordinate to gain or prevent turnovers.

In recent years, the advent of player tracking technologies has allowed for a greater variety of data to be collected that capture the interactions between sub-groups of players, off-the-ball (Lemmink & Frencken, 2013). For example, with regard to space, the general goal for the attacking team is to spread out across the width and length of the play space, while the defending team seeks to close down space, reducing the distance between players (Araujo, Ramos, & Lopes, 2016). These basic goals of attacking and defensive play, are observed in player behaviour that can be tracked with tools such as GPS, which allows for spatio-temporal information to be gathered to indicate the tactical intentions of different teams (Clemente, Couceiro, Fernando, Mendes, & Figueiredo, 2013). Spatio-temporal measures capture aspects of space and time to determine how teams position themselves across the play space (Alexander et al., 2019). Examples of these measures include; team centroid, team surface area, and team length and width or stretch index (Sampaio & Macas, 2012). The stretch index calculation measures the distance between players to assess the expansion or contraction of space in different game phases (Bourbousson, Sève, & McGarry, 2010). In

a football study, it was shown that team dispersion patterns can change depending on the style of defense (Frias & Duarte, 2014). When playing a zone style defence (where defenders defend space rather than a player), all players covered less surface area compared to what they did when the defenders were using a one-on-one defensive style (one defender marking one attacker). While these examples describe the patterns of behaviour that can lead to more or less successful behaviour, they still lack depth as to why these behaviours are used (i.e., why do players cover less area in zone style defence).

To date, the majority of studies exploring tactical behaviour have focused on invasion sports such as football, rugby, and AFL. While invasion sports have many similarities, a challenging issue for understanding invasion games from an ecological dynamics perspective, is that the constraints differ across sports. For example, when basketballers are in possession of the ball, they move by dribbling the ball with their hands, footballers kick the ball with their feet, and in rugby, players hold the ball and run with it. In contrast, netball is arguably a more complex sport as the player in possession of the ball cannot move more than one step; therefore, the task constraints in netball are very unique to other invasion sports. Consequently, further work is needed to develop our understanding of tactical behaviour in netball.

2.3 Netball specific tactical research

Netball is predominately a female sport, with limited global exposure; as such, there is a shortage of netball specific research available, especially looking at tactical behaviour (McClean et al., 2019). The few studies that have focused on tactical aspects of performance, have typically done so indirectly, by measuring decision making accuracy (Bock-Jonathan, Venter, & Bressan, 2007; Farrow, 2010), as well as adopting notational approaches to identify performance indicators that relate to successful performance (O'Donoghue et al., 2008). An overview of both the netball specific decision making and notational studies are explored below.

2.3.1 Netball specific decision-making studies

Bock-Jonathan et al. (2007) and Farrow (2010) conducted studies that sought to test a variety of technical and tactical components of performance in netballers competing at different levels. The participants in the Bock-Jonathan et al. (2007) study included

university aged netballers (from South Africa) organised into high, medium and low skill levels; while the participants in the Farrow (2010) study included elite netballers from Australian national squads including; the open squad, under 21 (U21), under 19 (U19) and under 17 (U17). In both of these studies, a computer based decision-making task was used to assess tactical knowledge. Participants were instructed to watch a variety of netball scenarios, which were stopped and occluded at a critical moment, prompting the participants to identify the best passing option. In the study conducted by Bock-Jonathan et al. (2007), the participants were given three options to choose from (for who to pass the ball to), while Farrow (2010), left the decision completely open (i.e., the participants were not given passing options to choose from). The results from Bock-Jonathan et al. (2007) indicate that there were no statistically significant differences in tactical knowledge for the three skill level groups. The authors suggested the possibility of ceiling effects, as the 'correct' decisions may have been too obvious. In contrast, the results from Farrow (2010), showed that the open and U21 age groups had better decision making accuracy than the U17 and U19 players. A potential rationale for these differing results could be due to the quality of the players involved in the studies, as the Australian study included elite netballers, whereas the South African study only included teams playing in an open university competition.

A common, and important, observation from the two decision making studies above is the presumption that there is one 'optimal' decision, meaning that the best decision is 'good' and all other options are 'bad' decisions (Araújo et al., 2019). This 'good-bad' dichotomy is observed in various assessment tools used to determine effective decision making such as the game performance evaluation tool (GPET). The GPET categorises two aspects of game performance, including decision making and skill execution (Gonzalez-Villora, Serra-Olivares, Pastor-Vicedo, & da Costa, 2015). The decision making component captures the tactical intentions of players as they face 'tactical problems' such as keeping possession of the ball, penetrating the defence and attacking the goal (Serra-Olivares, García-López, & Calderón, 2016b). The GPET, like many other decision-making tools, adopt the 'good or bad' view of decision-making, by coding decisions as appropriate or inappropriate. For example, a player is given a score of 1 if they pass to a team mate who is unmarked, and a score of 0 if they pass to a player who is marked (Gonzalez-Villora et al., 2015).

The 'optimal' decision approach is problematic because in complex, dynamic systems, such as team sport, there is no 'best' decision suitable for all players, in all contexts (Araújo et al., 2019). In addition, in video-based decision making tasks such as those used by Bock-Jonathan et al. (2007) and Farrow (2010), perception is decoupled from action meaning the participants are not required to execute a motor response, as is required in real-game contexts (Bruce et al., 2012b). When perception and action are coupled, research has shown that coupling does have an influence on performance compared to situations that are uncoupled (Dicks, Button, & Davids, 2010). In a football study, goal keepers faced penalty kicks in a variety of simulation and in-situ scenarios. The number of saves made was significantly higher in the in-situ conditions compared to the simulation scenarios (Dicks et al., 2010).

In order to test the expertise effect when a motor response is required in netball, Bruce et al. (2012b) created an in-situ perceptual-motor decision making task. The task involved a group of confederate actors playing out pre-determined netball scenarios, where participants of different skills levels (expert, developmental and 'lesser skilled') were incorporated. The participant was informed which confederate actor they would receive the ball from in each scenario, and they were then required to make a real-time decision about whom to pass to next. The results highlighted that the expertise effect was apparent when a motor response was required, as experts were more successful at coupling their decision (response selection) with the execution of that decision, compared to developing athletes (Bruce et al., 2012b). Therefore, studies that include sport-specific tasks, particularly through in situ decision making, are regarded as being more representative of the true performance context, which is important for assessing tactical competency (Bruce et al., 2012b).

2.3.2 Notational studies in netball

Of the few netball specific studies that have collected and analysed data from real netball matches, descriptive notational analyses have been used to identify performance indicators that relate to successful play. These indicators have included, successful and unsuccessful passes, turnovers, offensive and defensive rebounds, and penalties received (O'Donoghue et al., 2008; Pulling et al., 2016). A sample of 59 British National Super League netball games from 2005-2008 were analysed to identify the key performance indicators that differentiate between top of the table and bottom of the

table teams (O'Donoghue et al., 2008). The results indicate that across the 2005-2008 seasons, top of the table teams scored from 53.4% of their centre passes, and bottom of the table teams scored from 38.9% of their centre passes (referred to as the 'centre pass to score' or CP to score statistic (O'Donoghue et al., 2008). In addition, top of the table teams gained more intercepts, defensive rebounds, and turnovers and scored from more of those turnovers (referred to as the turnover to score, or T/O to score statistic) (O'Donoghue et al., 2008). This suggests that when a team is able to effectively score from their own centre pass, and score from the 'bonus' turnovers they create, they will be more successful (Pulling et al., 2016). However, from these statistics it is difficult to determine the specific behaviours that are used to create these successful patterns of play, or help us understand why turnovers occur in netball.

2.4 Why do turnovers occur in netball?

When considering why turnovers occur in netball, one netball specific study sought to identify the contextual factors that influence passing errors. In that study, notational analysis was used to assess the decision making abilities of expert and developing (U17 representative) players (Bruce, Farrow, Raynor, & May, 2009). International test matches between the Australian Diamonds and the Silver Ferns from 2006 and an U17 tournament were recorded to code each possession of the ball and changes of possession (turnovers) in each game. A variety of game characteristics were coded such as error type and decision-making complexity. In this study, error type was coded as being 'with-in reach' of the intended receiver, 'out of reach' of the intended receiver, or due to a rule infringement. The results highlighted that there were significantly more errors that were coded as being within reach ($81.45 \pm 15.73\%$) compared to errors that were coded as being out of reach ($12.26 \pm 15.58\%$) which, in turn, were significantly greater than the number of rule infringement errors ($6.30 \pm 7.83\%$) (Bruce et al., 2009, p. 250). Contrary to much of the research that focuses on the errors of the 'passer' (the player who threw the poor pass), this finding suggests that even when the passer places the ball correctly (with-in reach), errors are still made, which may be attributed to the actions of the intended receiver (i.e., the off-the-ball behaviours).

Bruce et al. (2009) also included decision making complexity as another measure with the potential to impact passing errors in netball. Bruce et al. (2009) defined decision making complexity as the number of passing options available. Three or more

passing options were associated with high decision making complexity, while one or two passing options was associated with low decision making complexity (Bruce et al., 2009). The results from this study highlight that the experts consistently had higher decisional complexity (more passing options) compared to the developing players, and for both skill level groups, increased decision complexity was related to more passing errors. While these findings are interesting, it may not simply be the quantity of options available that causes error; rather, the quality of those passing options. For example, the off-the-ball behaviours of an attacking player can create good quality information (using strong decisive movements, clear body angles, and using free space) to communicate to the passer where to pass the ball. However, if there is any ambiguity or indecisiveness in the attacking player's movements, this will create more decisional complexity for the passer. Therefore, rather than stating that the quantity of options results in errors as shown in Bruce et al. (2009), it may also be important to note the wider contextual variables that indicate the quality of those options.

In general, the netball specific research, described above, has tended to focus on isolated components of performance without understanding the interactions between them, or interdependencies between team members. These reductionist and deterministic approaches to performance analysis restrict what we can learn and understand from complex team sports (McClean et al., 2019). In recent research, the need for a more holistic, systematic approach for understanding team behaviour in netball has been adopted. McClean et al. (2019) conducted a work domain analysis (WDA), which is a method used to identify the constraints present in a system. Using 'subject matter experts', workshops were conducted to develop a model of netball that highlights the multiple interacting factors that influence match performance. Turnovers were identified as an important measure; however, rather than simply measuring the frequency of turnovers, the model includes 'purpose related functions' to guide a higher level of analysis to explain how teams maintain or gain possession of the ball and why certain behaviours can be regarded as tactical or not. A 'purpose related function' refers to functions (actions) that need to be performed to make sure functional purposes are achieved. For example, a functional purpose of netball is to win the game or implement a game plan; and some of the 'purpose related functions' include maintaining unit structures, creating unpredictability for opponents and controlling

momentum (McClean et al., 2019). These 'purpose related functions' form a foundation for understanding turnovers in netball. However, further clarification of the mechanisms or specific tactical behaviours that contribute to turnovers are needed. Therefore, a key question to consider is what tactical behaviours the defensive players were using to create this advantage, and what did the attacking players fail to do.

Summary

The literature review presented in this chapter has focussed on the different terminology used to define and explain tactical behaviour, as well as a variety of measures used to assess tactical behaviour in team sport. A key point to consider from this literature review is the lack of knowledge about the off-the-ball behaviours that create turnovers in team sport. In order to determine why turnovers occur, it is important to understand the processes behind changes of possession. The current thesis will attempt to theoretically rationalise a shift away from simple cause-effect notational analysis, and highlight how understanding tactical behaviour through an ecological dynamics lens enables a better understanding of tactical behaviour. The following chapter provides an account of the research philosophy and methodology underpinning the intended research.

Chapter 3 Research philosophy and methodology

The literature review chapter highlighted the complexities and inconsistencies with defining tactical behaviour in invasion sports and, more specifically, the lack of netball specific research in the field. Whilst some sports have drawn upon expert knowledge (such as using experienced coaches) to examine tactical behaviour (Costa et al., 2011; Oslin et al., 1998), netball has received very little analysis in the literature. To address this problem, the intent of the current research was to utilise expert knowledge for the development and validation of a resource for understanding tactical competency in netball. With the solicitation and synthesis of expert knowledge, an appropriate research paradigm was of utmost importance to ensure relevance and representativeness of the data were maintained throughout the research process.

Any research process typically includes four elements: epistemology, theoretical perspective, methodology and methods (Crotty, 1998). The research process adopted for this current thesis is shown in Figure 5 below and will be expanded upon in this chapter.

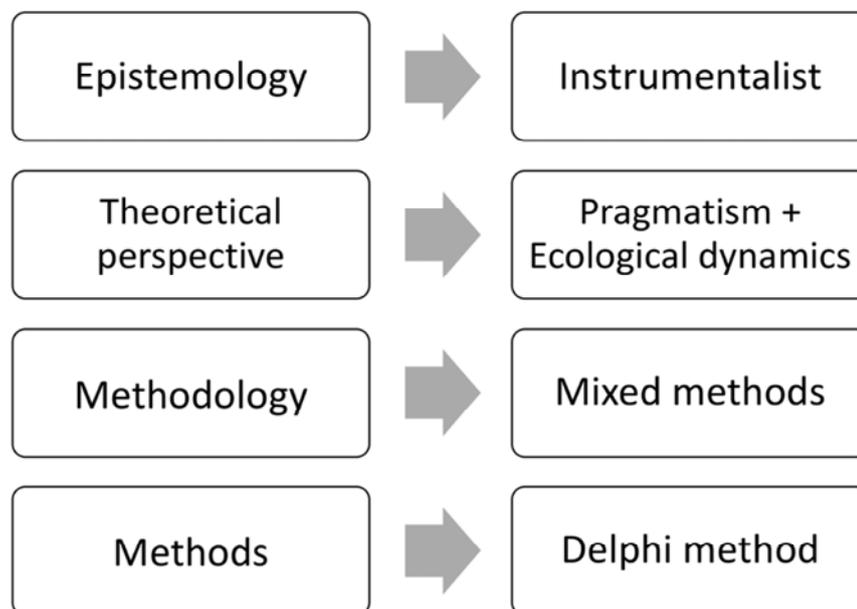


Figure 5: Organisation of the research process used in this thesis, as it fits within the four research elements identified by (Crotty, 1998)

The choice of a mixed methods approach was driven by the research questions this thesis was seeking to answer (Teddlie & Tashakkori, 2003). The research questions were focused on gaining practical and applied knowledge to solve a particular problem.

The primary problem for this thesis was the lack of netball specific research available, therefore, this gap in knowledge was best filled using both qualitative and quantitative methods of inquiry to capture rich and meaningful data (Plano-Clark & Creswell, 2008). Further justification for the use of a mixed methods approach was its strong association to the pragmatist research paradigm, which is traditionally a problem focused approach (Teddlie & Tashakkori, 2003). Having a research paradigm that prioritises the practical value of the research, enables solution based research to be conducted, which was necessary for this current research.

Pragmatic researchers are not concerned with an objective truth or the pursuit of a single version of reality; rather, it is the extent to which research findings help to make predictions or solve conceptual problems that is important (Giacobbi, Poczwardowski, & Hager, 2005). From this perspective, the value of knowledge is not based on whether it is true or not, but on the extent to which it achieves its external consequences (Bishop, 2015). This current research is influenced specifically by John Dewey's philosophy of pragmatism (Dewey, 1906, 1922). Dewey differs from other popular pragmatists, such as Charles Peirce and William James, as his philosophy has alignment to ideas espoused in ecological dynamics. Dewey rejected the strict dualism between the body and the mind (perception and action) common in Cartesian thinking (Bacon, 2012). Rather, like an ecological dynamics approach purports, Dewey believed that we experience the world as moving objects interacting with each other and the outside world (Bacon, 2012). The introductory chapter of this thesis highlighted ecological dynamics as the theoretical foundation of this research. Therefore, it is important to briefly expand on the commonalities shared between ecological dynamics (specifically the ecological psychology component) and pragmatism, and why they are both incorporated as the theoretical perspective of this thesis.

Ecological psychology is an approach pioneered by J. J. Gibson (1986) which draws on American pragmatists such as William James (Heras-Escribano, 2019). One of the key ideas built upon by Gibson, was James' notion of radical empiricism, which is the position that knowledge of the world comes from experience and one's capacity to engage with the world (Lobo, Heras-Escribano, & Travieso, 2018). For a radical empiricist, perception is direct, as it is an emergent property, where perception and thought are derived from action, not an internal representation of past events like a

cognitivist perspective purports (Chemero, 2003). The radical empiricist notion of perception has been directly related to Gibson's notion of affordances, as affordances refer to the possibilities of action, i.e., how engaging with ecologically available information informs action (Heras-Escribano, 2019). It should be noted that "the major innovation of ecological psychology was to sophisticate the ontology of perception and the scientific methodology to analyse them in purely experimental terms" (Heras-Escribano, 2019, p. 18). In a practical sense, this means looking at behaviour through a relational lens, where interactions between organisms and environments produce action. In this way, affordances are best captured as practical possibilities available in different contexts.

Ontologically speaking, Dewey's pragmatism is a philosophy of practice, where beliefs are true only if they work for solving problems (Biesta, 2010; Tashakkori & Teddlie, 2010). Deweyan pragmatism accepts the existence of reality; however, refutes the notion of one version of reality, asserting that reality is constantly changing based on experience with the external world (Dewey, 1922). As such, Dewey's pragmatism links with an ecological worldview, where on-going interactions with the environment construct one's experience of reality. Given the ever-evolving nature of reality, Dewey advocated that human behaviour can only be understood in relation to the context in which it is performed (Dewey, 1922). This ties to the idea of organism-environment inseparability that was first proposed by Gibson and elaborated by later ecological theorists (Biesta, 2010). This ontological perspective creates an understanding of reality, while epistemology is the study of understanding and explaining how one knows what they know (Crotty, 1998). Dewey's theory of knowing (epistemology) is related to the notion of a transactional experience, where knowing is the result of acting (Biesta, 2010). Pragmatists view learning and knowing as a dynamic, interactive process, where an instrumentalist epistemology is adopted that emphasises that knowledge is a tool for solving problems (Maxcy, 2003).

As pragmatism is not concerned with uncovering a single reality or objective truth, the success of pragmatist research is judged on the value it has to external outcomes (Bishop, 2015). One of the external outcomes of this research was to create a guideline for defining, identifying and assessing tactical behaviour. To do this, various expert coaches were recruited to gather their knowledge to create a list of tactical

behaviour definitions that all of the coaches agreed upon. The unification of opinion (through coach agreement) may seem at odds to a pragmatist philosophy (that rejects the notion of one truth); however, the desire to gain consensus or agreement over the definitions included in the guideline was not to create one version of reality. Rather, the intention was to create a guideline that captures multiple perspectives that can be adapted as necessary.

A number of consensus based research techniques have been designed to collect and distill expert opinion, including nominal group techniques and the Delphi method (Hasson, Keeney, & McKenna, 2000). Nominal group technique involves gathering a group of experts together to partake in a highly structured meeting to generate information in response to an issue and prioritise information for decision making (Jones & Hunter, 1995). While nominal group techniques are popular, the Delphi method was selected as the preferred method for two reasons. To begin with, a nominal group technique would have been logistically difficult as it requires all the experts to be together at the same time, in one location. Secondly, the nominal group technique does not provide the coaches with any confidentiality, which is problematic when the expert coaches involved in the study are from rival teams. As such coaches may be less willing to share their thoughts in front of coaches who their respective teams compete against in the competition season. The Delphi method was therefore selected for this thesis (see chapter four), as its procedural flexibility allowed for individual interviews to be conducted, as well as a confidential consensus forming process. In addition to the adaptability of the method, the Delphi has recently been adopted in a variety of sport specific contexts, including tennis (Krause, Farrow, Reid, Buszard, & Pinder, 2018), rugby league (Cupples & O'Connor, 2011; Krause et al., 2018) and football (Morley, Morgan, McKenna, & Nicholls, 2014).

The Delphi method involves recruiting an expert panel in order to complete multiple rounds of a questionnaire to generate information and seek consensus (Powell, 2002). Each round is interspersed with controlled feedback (filtered through the researcher) to collate and summarise the collective opinion of the expert panel (Hsu & Sandford, 2007). The results are often used to inform decision making around developing practice and policy (Brady, 2015). The Delphi method is thought to be more effective than one-on-one interviews as the controlled feedback provides each expert

with an indication of where their opinion fits in relation to the group (Cupples & O'Connor, 2011). This anonymous process gives the experts the opportunity to distill, refine and re-conceptualise their judgments between rounds without the perceived pressure or bias of dominant personalities (Hsu & Sandford, 2007). Traditionally, the Delphi method consisted of multiple rounds of completing the questionnaire that produced quantitative data. However, a common modification is the use of a qualitative interview in the first round of data collection (Keeny, Hasson, & McKenna, 2011).

3.1 Delphi method: Research paradigms

As the Delphi method traditionally uses quantitative surveys, it has typically been associated with the positivist paradigm, wherein the researcher is seen to play an unbiased role in discovering universal laws or truth through gathering and analysing quantitative data (Ponterotto, Mathew, & Raughley, 2013). Within this positivist perspective, there is an assumption that reality exists and is objectively discoverable through the verification of hypotheses (Ponterotto et al., 2013). Under a positivist research paradigm, the endeavor to reach consensus is seen as experts agreeing on one version of reality (Keeny et al., 2011). However, the procedural flexibility of the Delphi method, allows for qualitative modifications to the research process to be made, creating a mixed-methods research design more commonly associated with the pragmatist research paradigm (Guba & Lincoln, 1994). Rather than working from a positivist position that there is one single reality, researchers adopting a pragmatist lens can be open to multiple realities (Ponterotto et al., 2013).

A pragmatic inquirer (researcher) seeks to engage in a reflective research process where there is a continual engagement with the community (Greene & Hall, 2010). As the Delphi method involves multiple iterative rounds, it allows researchers to assess multiple lines of questioning in order to verify the participants' world views and not their own worldview. In this way, the researcher's role is never assumed to be objective; rather, it involves a dialectical interchange of ideas as the researcher plays an important role in capturing expert knowledge and their descriptions of their reality (Sandelowski, 2000). As such, the Delphi method was deemed to be a good fit with the pragmatist paradigm, as it is procedurally driven, reflexive, iterative and seeks to create actionable knowledge to solve important problems (Greene & Hall, 2010).

3.2 Research design

According to pragmatist epistemology, the best research design is one that allows researchers to solve the practical problem at hand (Bishop, 2015). Plano-Clark and Creswell (2007) originally identified four designs for mixed methods research; explanatory, exploratory, triangulation and embedded designs. This has since been expanded to six design types including sequential explanatory, sequential exploratory, sequential transformative, concurrent triangulation, concurrent nested and concurrent transformative (Creswell, Plano-Clark, Gutmann, & Hanson, 2003). The Delphi method used in this current research, utilised a sequential exploratory design, where the first stage of data were collected and analysed before the second stage began. A sequential exploratory design begins with and prioritises qualitative data collection and is followed by quantitative data collection and analysis (Creswell et al., 2003). The initial collection of qualitative data allows for a broad scope of information to be gathered from the experts, which is particularly helpful when little is known about a topic. The subsequent quantitative data can then be gathered to narrow down the important data, confirm information or assist in explaining and interpreting the findings (Creswell et al., 2003). In this way, this research design was preferred over others, because very little is known about tactical behaviour in netball. If a quantitative method was utilised first, it may have prematurely narrowed down the data, not allowing for a full scope of knowledge to be captured.

It should be noted, that in this chapter I have only discussed how the pragmatist paradigm informed the first study of this thesis (in chapter four). However, the pragmatist paradigm did inform the whole thesis. This is particularly evident when this thesis is understood under Dewey's notion of inquiry. Study one, represented an initial stage of inquiry, where a problem is acknowledged (lack of netball specific research) and investigated to seek solutions. Dewey suggested that the findings from an initial stage of inquiry (from chapter four) must then be turned back onto the performance context, where they can be tested and verified and connected to action (Maxcy, 2003). This testing and verification process are reported in chapters five and six of the thesis.

Chapter 4 Defining tactical competency during turnovers in netball: Using the Delphi method to capture expert coach knowledge

This chapter comprises of the journal article submitted and accepted for publication to the Journal of Sport and Exercise Science.

4.1 Abstract

Traditional methods for understanding change of possession (turnovers) in team-based invasion sports have not accounted for how the dynamic, interactive actions of multiple players contribute to turnovers. One approach is to access the expertise of highly skilled coaches to determine the important tactical behaviours that create turnovers. In this study, we synthesised expert opinion from 12 experienced netball coaches with a consensus-based method (the Delphi method). The expert group undertook one-on-one interviews which were coded using thematic analysis to identify and code tactical constructs. From this analysis, a preliminary list of tactical behaviour definitions were created and used for the subsequent rounds of data collection and analysis. Two rounds of questionnaire followed the initial interviews to validate the list of tactical behaviour definitions. As a result, the tactical principles guideline (TPG) was developed which included nine attacking tactical behaviours and nine defensive tactical behaviours. The tactical behaviours can be grouped thematically into four overarching tactical principles, including; space and movement, timing, support and reading play. The four tactical principles can be observed in the interactions between multiple players highlighting that, in high level netball, turnovers typically result from team dynamics rather than from individual player behaviour (i.e., a poorly executed pass). Therefore, when using game statistics to assess performance, it is important to acknowledge that errors and successes are the result of the interactions of multiple players on court, and not solely a reflection of individual players' tactical ability. The TPG has been incorporated into a Netball New Zealand player profiling tool as it is seen to be the first step in enhancing the effectiveness of coach and player communication, tactical behaviour assessment, as well as informing selection processes.

4.2 Introduction

The evaluation of tactical behaviour in team sports is a growing research area (Gonzalez-Villora et al., 2015). Given the inherently agonistic relationship that exists between opposition teams, the tactical behaviours which emerge can provide coaches, players and performance analysts with meaningful information about the tactical demands of the sport (Silva, Garganta, Araújo, Davids, & Aguiar, 2013). Notational analysis methods are often used in team sports to identify the performance indicators that describe successful or unsuccessful performance (Correia et al., 2013). For example, statistics such as turnovers won or lost, passing frequencies and penalties given, are collected and then used to discriminate between winning and losing teams, in order to describe the quality of a performance (Garcia, Ibanez, De Santos, Leite, & Sampaio, 2013; Hughes & Bartlett, 2002). In recent literature, a variety of performance variables have been shown to be related to match outcome. For example, in Rugby 7's, successful teams have been shown to win more lineouts from an opposition's throw (Higham, Hopkins, Pyne, & Anson, 2014); in basketball, winning teams gain more defensive rebounds (Garcia et al., 2013); and in handball, winning teams have a lower number of red card offenses (Saavedra, Porgeirsson, Chang, Kristjánssdóttir, & García-Hermoso, 2018). However, within the performance analysis literature, it is acknowledged that recording these descriptive measures in isolation does little to provide an appropriate level of explanation for the complex inter and intra team dynamics that occur on the sports field (McClean et al., 2019).

In order to extend our knowledge of tactical behaviour from simple description to an informative explanation, it is important to first define what a tactical behaviour is. In general terms, a 'tactic' is a means to achieve a specific objective, like to gain advantage over an opposition (Garganta, 2009). In team sports, successful tactical behaviour is typically associated with successful skill execution, as a decision only becomes valid once it is translated into action (Grehaigne, Godbout, & Bouthier, 2001). While many team sports are suitable to explore tactical behaviours, this study will focus on netball. Netball is a 7v7 court-based invasion sport, played mostly by women in commonwealth countries (Croft, Willcox, & Lamb, 2018).

In netball, like other invasion sports, the overall objective is to outscore an opposition team; however, netball has many unique rules that dictate how the game can be played (Croft et al., 2018). For example, the player in possession of the ball

cannot take more than one step and must pass the ball within three seconds of receiving it (Pulling et al., 2016). These rules mean that the player in possession of the ball (the 'passer') is heavily reliant on their teammates to create passing options for them to avoid losing possession of the ball. In addition, as netball is defined as a 'non-contact' sport, there are rules that restrict how defenders can regain possession (INF, 2016). The 'obstruction' rule states that a defender cannot defend within 0.9m of a player in possession of the ball; therefore, in order to legally gain possession, defensive players must force errors (e.g., force the attacking team to throw the ball out of court, hold the ball too long or take an extra step), or they can attempt to gain possession when the ball is in flight; by intercepting the ball (INF, 2016).

In netball, various performance indicators, such as successful and unsuccessful passes, goal scoring variables, turnovers, offensive and defensive rebounds, and penalties received have previously been reported (Croft et al., 2018; Mclean et al., 2019; O'Donoghue et al., 2008; Pulling et al., 2016). For example, a sample of 59 British National Super League netball games from 2005-2008 were analysed to identify the key performance indicators that differentiate between top of the table and bottom of the table teams (O'Donoghue et al., 2008). The results indicate that across the 2005-2008 seasons, top of the table teams scored from 53.4% of their centre passes, and bottom of the table teams scored from 38.9% of their centre passes (referred to as the 'centre pass to score' or CP to score statistic) (O'Donoghue et al., 2008). In addition, top of the table teams gained more intercepts, defensive rebounds, turnovers and scored from more of those turnovers (referred to as the 'turnover to score' or T/O to score statistic) (O'Donoghue et al., 2008). This suggests that when a team is able to effectively score from their own centre pass, and score from the 'bonus' turnovers they create, they will be more successful (Pulling et al., 2016). However, from these statistics we are unable to determine the specific behaviours that are used to create these successful patterns of play, or help understand why turnovers occur in netball.

As with research into other invasion sports, performance indicators are often measured without context and without considering the team interdependencies that produce successful or unsuccessful behaviour (Mclean et al., 2019). A study conducted by Bruce et al. (2009), attempted to identify the contextual factors influencing pass decision making in netball, using concepts such as decisional complexity; measured through the number of passing options available for a passer. Decisional complexity was

shown to be related to an increase in passing errors when multiple passing options were available compared to when only one passing option was available, irrespective of the player's skill level (Bruce et al., 2009). While these findings are noteworthy, the authors did not specify what constitutes an 'available option' (i.e., is availability defined as a player who is completely unmarked?). This is important because, in netball, different styles of defence dictate the proximity of the defender to the attacker, and although a player may appear marked or unmarked, they can still be perceived as a good option depending on their movement and positioning. If there is any ambiguity or indecisiveness in a player's movements, this will create more decisional complexity for the passer. Therefore, rather than stating that the quantity of options results in errors, as shown in Bruce et al. (2009), it may also be important to note the wider contextual variables that indicate the quality of those options.

In recent research, Mclean et al. (2019), identified the need for a more holistic, systematic approach for understanding team behaviour in netball that moves beyond the reductionist notational methods currently being adopted. Using 'subject matter experts', Mclean et al. (2019) conducted a workshop to develop a model of netball to highlight the multiple interacting factors that influence match performance. Turnovers were identified as an important measure; however, rather than simply measuring the frequency of turnovers, the model that was created, includes 'purpose related functions' to guide a higher level of analysis to explain how teams maintain or gain possession of the ball (prevent or gain turnovers). For example, maintaining unit structures, creating unpredictability for your opponents and controlling momentum were identified as key aspects of match performance in netball (Mclean et al., 2019). These 'purpose related functions' form a foundation for understanding turnovers in netball. However, further clarification of the mechanisms or specific behaviours that contribute to turnovers are needed; that is, how do players control momentum, what does it look like when players control momentum?

The use of 'subjects matter experts' in the above research emphasises the need to incorporate the unique knowledge of experts into applied sports science research (McLean et al., 2017). The Delphi method, is another method used to solicit expert knowledge, which is used to collate and synthesise opinions to create group consensus across multiple rounds of questionnaires (Hsu & Sandford, 2007; Mullen, 2003). While

the Delphi method has been used extensively in health and social science research, there are fewer sports science studies that have used this method to capture expert knowledge (Morley et al., 2014). One exception was Cupples and O'Connor (2011), who sought to identify the performance indicators of junior rugby league players to create a practical guide for identifying, selecting and retaining athletic potential. Unlike many studies that have a heavy focus on the physical attributes of performance, Cupples and O'Connor (2011) described many cognitive, psychological and game skill factors as key indicators of higher performing athletes. Similarly, using the Delphi method, Morley et al. (2014) looked at the developmental features that encompass elite junior academy footballers. In both the aforementioned studies, it was recognised that using expert coach knowledge to develop guidelines or frameworks for player development pathways can maximise the engagement and respect for the tool.

The aim of the current study seeks to identify and clearly define the tactical behaviours that contribute to turnovers in netball. Through gathering expert opinion with a consensus-based method (the Delphi method), a practical framework for defining tactical behaviour will be created with multiple applications for coach and player development. The expected outcome of this research will be a list of tactical behaviour definitions, called the tactical behaviours guideline (TPG). These data are intended to be used to identify, assess and develop tactical competency in players, by drawing attention to the specific tactical behaviours that can create and prevent turnovers in netball.

4.3 Methods

4.3.1 Participants

A sample of netball experts were invited to participate in the research. Criteria for participation included having over 10 years of coaching experience. A total of 12 experts agreed to be involved in this study. Nine of the experts were head or assistant coaches in elite competitions (domestic and international), and one expert had coached at representative age group levels and had over 50 Silver Ferns test caps as a player. Although this expert had no experience coaching at the elite level, she has been involved at the elite level as a player for many years and thus had valuable knowledge to add. This group of experts are highly regarded in New Zealand Netball, with over 550

Silver Ferns test caps between them as either coaches or players, as well as extensive experience coaching and playing at the elite domestic level both in New Zealand and overseas. The attrition rate was low overall, with only two experts withdrawing after round one, and one expert withdrawing after round two. No explanations were offered for these withdrawals. The data gathered from these participants were still used regardless of their withdrawal.

Ethical Clearance

Ethical approval was attained through AUTECH (16/436) on the 14th of September 2017. Evidence of ethical approval can be found in Appendix A and B.

4.3.2 Procedure

The Delphi method was selected to collect and distil the opinions and knowledge of the expert participants to create a list of tactical behaviour definitions. The Delphi method consisted of three rounds of data collection interspersed with analysis and feedback. The specific steps are outlined in Figure 6 below.

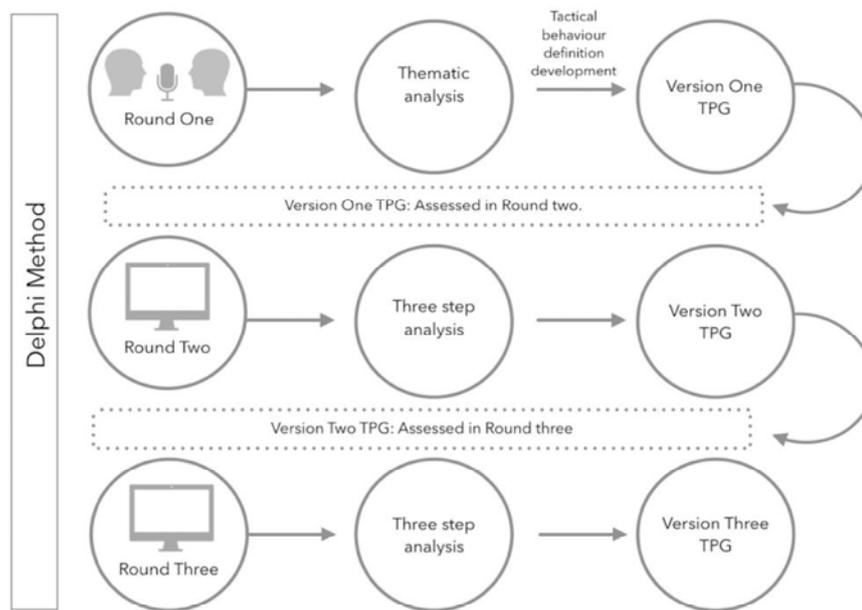


Figure 6: Outline of the Delphi research procedure

Traditionally, the Delphi method consists of multiple rounds of completing a questionnaire that produce quantitative data. A common modification is the use of one-on-one, semi-structured interviews in the first round of data collection (Keeny et al., 2011). This modification has been used in previous research (Cupples & O'Connor,

2011; Paul & Donna, 2017) to allow for more open-ended, explorative questions to be used to produce multifaceted answers to the research question. The subsequent Delphi rounds then consisted of online questionnaires. The details of each round of interview and questionnaire are explained below.

Round 1: Each expert was interviewed in person by the first author with one interview conducted via Skype. Information sheets were read and consent forms were signed before the interview commenced (these forms can be found in Appendix C and Appendix D). The experts were guided by the broad question; “how do turnovers come about in netball?” and were prompted to discuss and describe the key tactical behaviours used to create or prevent turnovers. Specifically, two questions; “what is done well on defence to create turnover opportunities” and “what is done well on attack to prevent turnovers” were written on a large sheet of paper, where the coaches had the opportunity to write down key areas to discuss. Probing questions were used to guide the conversation, such as; “can you explain what it looks like”, “can you provide an example”, until the expert could not provide any new information. Following the interviews, the research team analysed the expert responses to create a list of tactical behaviour definitions. These definitions were categorised into defensive and attacking behaviours and were used to create version one of the TPG (details in the data analysis section below).

Round 2: Using the tactical behaviour definitions developed in round one, an online questionnaire was created to enable the experts to rate their agreement to each of the definitions using a 4-point Likert scale; 4: strongly agree, no changes needed, 3: agree, minor changes needed, 2: disagree, major changes needed, 1: strongly disagree, should be excluded. If the definition was rated a three, two, or a one; the experts were given the opportunity to write amendments to the definition. If the tactical behaviour was rated as a one, the expert did not agree with the definition and believed the tactical behaviour should be excluded from the TPG (i.e., the tactical behaviour was not relevant).

While the primary intention was to create a list of definitions that expert coaches agreed upon, it was also valuable to ensure that all the tactical behaviours in the TPG were considered important. In order to establish which behaviours were

important, the experts were asked to rank each of the tactical behaviours for their level of importance for creating turnovers on defence, and preventing turnovers on attack. The experts classified each tactical behaviour into one of four categories including; 4: very important, 3: important, 2: somewhat important, 1: not important (delete). Based on the level of agreement and rank score for each definition, the research team analysed the results and, where necessary, re-wrote the definitions to align with the experts suggested amendments to create version two of the TPG (details are provided in data analysis section below).

Round 3: The procedure for round two was repeated and the results were analysed to inform the development of the final version of the TPG (version three).

4.4 Data analysis

Round one

The overall aim of the analysis was to produce a list of tactical behaviour definitions which were agreed upon by the experts. Following round one, the interview data were analysed using thematic analysis. Thematic analysis includes six steps: i) familiarisation, ii) generating initial codes, iii) searching for themes, iv) reviewing themes, v) defining and naming themes and vi) producing the report (Braun & Clarke, 2006). Following this six step process, the interviews were transcribed verbatim and prepared for qualitative analysis. The primary researcher became familiar with the data through listening to the audio and reading the transcripts multiple times. The coding tool, NVivo, was used to aid in the organisation of codes. Each transcript was systematically read through to identify any interesting extracts within the text. Initial codes were inclusive of any areas of interest that related to the research question; 'how do turnovers come about'? Each relevant section of text was tagged and sorted into the appropriate code within NVivo. This process was repeated twice through the data set to ensure that all relevant text were categorised into the appropriate codes. Codes were then sorted into potential themes by reading the extracts and combining similar codes. The second author independently cross-coded a section of the transcripts to ensure consistency in the coding process and discussions were had until agreement was reached. Each major theme that was identified was developed into a short definition with a title to describe the tactical behaviour. A small pilot study was conducted to ensure the tactical behaviour definitions were comprehensible before presenting them back to the original

experts. This required two authors (AC & SKM), as well as a netball participant (a local umpire), to read through the definitions and provide feedback. Following this pilot study, some very minor changes (one or two words) were made to four of the definitions.

Rounds two and three

For rounds two and three, quantitative and qualitative data were used to inform the revision of the tactical behaviour definitions that were developed in round one. The aim of the analysis for rounds two and three was to strengthen the validity of the definitions between each iteration, until the required level of consensus was reached (explained in the content validity section below). A secondary aim was to decrease the larger list of tactical behaviours into a smaller, more refined list, with only the most important tactical behaviours included. The process for editing the definitions and refining the list of behaviours is explained below.

Content Validity: I-CVI and S-CVI

The 'item content validity index' (I-CVI) was used for each tactical behaviour definition to determine the strength of the agreement amongst the experts. Using the expert ratings of agreement, the I-CVI score was calculated by the proportion of experts who rated the definition a three or a four (agree or strongly agree to the definition) on the four point scale (Lynn, 1985; Polit & Beck, 2006). A conservative I-CVI score of 0.80 (80% of the participants) was considered content valid for this study, as only a small number of experts were involved (Lynn, 1985). The S-CVI (scale content validity) score is the content validity of the whole scale (TPG) and was calculated by using the average I-CVI scores for all 18 tactical behaviour definitions within the TPG.

Rank order

Means and standard deviations were calculated to determine the average rank each tactical behaviour was given (from very important, to not important, delete).

Qualitative review

A qualitative review of a definition was conducted when the content validity (I-CVI) was below 80% or the tactical behaviour was ranked as 'somewhat important' or 'not important, delete'. The suggested amendments provided by the experts were then analysed to determine whether any changes should be made to each definition, or if it should be deleted. This process was completed on a case-by-case basis using the

following steps; 1) all suggested amendments were summarised and were presented to the first two authors of this paper, 2) the suggested amendments were read through to look for common themes, 3) the first two authors re-wrote the definitions using the most common suggestions.

4.5 Results

Results: round one

Six overarching themes were identified in the analysis including; (i) Space and movement, (ii) Timing, (iii) Deception, (iv) Support, (v) Reading play and (vi) Team cohesion. These six themes were defined as the tactical principles of netball. Sitting within these tactical principles, 26 tactical behaviours were identified and defined, which are organised into attacking, and defensive tactical behaviours. The attacking tactical behaviours include behaviours that the attacking team use to prevent turnovers from occurring, and the defensive tactical behaviours include behaviours that the defensive team use to create turnovers. The full list of tactical behaviour definitions is shown in Appendix E.

Table 4: Version one of the tactical principles guideline (TPG)

Tactical principles	Defensive tactical behaviours	Attacking tactical behaviours
Space and Movement	Court coverage	Continuous movement
	Continuous movement	Holding
	Attack the line of the ball	Penetration
	Deny catch space	Balance
	Dictate movement	Decisive movement
Timing	Delay and disrupt ball off load	Reset
		Ball speed
		Getting free
Support	Defensive unity	Options to the ball
	Full team defence	
Reading play	Reading patterns	Option selection
	Space awareness	Space awareness
Deception	Isolate	Decoy movements/fakes
Team cohesion	Role clarity within unit	Role clarity within unit
	Communication	Communication
	Adapting to player tendencies	Adapting to player tendencies

An additional resource is provided in Appendix F that highlights some of the key quotes from expert coaches that were used following round one to create the tactical behaviour definitions.

Results: Round two and three

Content validity

In version one, consensus was reached ($I-CVI \geq 0.80$) for 23 of the 26 tactical behaviour definitions, with an $S-CVI/Ave$ score of 0.90 (90% agreement for the definitions). In version two, consensus was reached for all 18 tactical behaviour definitions with an $S-CVI/Ave$ score of 0.98 (98% agreement for the definitions). See for the $I-CVI$ scores for the individual tactical behaviours in Table 5 below.

Rank order

In version one of the TPG, 12 out of 26 tactical behaviours were ranked in the 'somewhat important' (2) or the 'not important, delete' (1) categories, including seven attacking tactical behaviours; penetration, ball speed, continuous movement, decoy movements/fake, awareness of player tendencies, reset, and holding, and five defensive tactical behaviours; deny catch space, delay and disrupt ball off-load, court coverage, awareness of player tendencies, isolate. These tactical behaviours risked being deleted from the TPG. The remaining attacking and defensive tactical behaviours were all rated in the 'important' category, with options to the ball, getting free and decisive movement ranked as the top attacking tactical behaviours, and dictate movement as the top defensive tactical behaviour. In version two of the TPG all 18 tactical behaviours we ranked in the average category. Refer to Table 5 below to see the rank given to each tactical behaviour for rounds two and three.

Table 5: I-CVI scores and rank order for the attacking and defensive tactical behaviours

ATTACKING TACTICAL BEHAVIOURS							
Round Two: Version One				Round Three: Version Two			
Tactical behaviours	I-CVI	Rank	Qualitative review	Tactical behaviours	I-CVI	Rank	Qualitative review
Continuous movement	80%	11	Deleted				
Holding	100%	15	Definition change	<i>Protect space</i>	100%	8	No change
Penetration	90%	9=	Deleted				
Balance	90%	8	No change		100%	5	<i>Court balance</i>
Decisive movement	100%	2=	Definition change.		100%	1=	No change
Reset	100%	14	Deleted				
Ball speed	90%	9=	Definition change	<i>Pace of the ball</i>	89%	6=	No change
Getting free	90%	2=	Definition change		100%	1=	No change
Decoy movements/fakes	80%	12	Definition change	<i>Draw or fake</i>	89%	9	No change
Options to the ball	100%	4	No change		100%	1=	No change
Option selection	90%	1	Definition change		89%	4	No change
Space awareness	90%	7	Definition change		89%	6=	No change
Role clarity	100%	6	Deleted				
Communication	100%	5	Deleted				
Player tendencies	90%	13	Deleted				
DEFENSIVE TACTICAL BEHAVIOURS							
Round Two: Version One				Round Three: Version Two			
Tactical behaviours	I-CVI	Rank	Qualitative review	Tactical behaviours	I-CVI	Rank	Qualitative review
Court coverage	80%	12	Deleted				
Continuous movement	80%	8=	Definition change	<i>Confuse space</i>	100%	4=	No change
Attack the line of the ball	50%	7	Definition change		100%	2=	No change
Deny catch space	70%	10=	Definition change	<i>Contest catch space</i>	100%	4=	Definition change
Dictate movement	100%	3=	Definition change		100%	1	No change
Delay and disrupt ball off-load	90%	10=	No change		100%	7=	No change
Isolate	70%	14	Deleted				
Defensive unity	90%	1	Definition change		100%	7=	No change
Full team defence	100%	3=	Definition change		100%	2=	Definition change
Reading patterns	100%	8=	Definition change		100%	6	No change
Space awareness	100%	2	No change		100%	9	No change
Role clarity	100%	3=	Deleted				
Communication	100%	3=	Deleted				
Player tendencies	90%	13	Deleted				

Qualitative review

Despite the high level of consensus achieved for the 26 tactical behaviour definitions, the suggested amendments made by the experts highlighted that further refinements were needed. The research team reviewed the definitions on a case-by-case basis to look for common themes in the suggested amendments. In some cases, the experts suggested changes for the tactical behaviour title, shown in *italics* in Table 5 above. For example, the tactical behaviour title, ball speed was changed to pace of the ball. Two in-depth examples of the qualitative review process are provided in Table 6 and Table 7 below showing both a change of definition, and a change in title.

In round two, continuous movement was ranked eighth equal out of 14 tactical behaviours, and while the I-CVI score was sufficient (80% agreement), the suggested amendments made by the experts highlighted some minor changes that could be made. As shown in Table 6 below, experts four, six and eight, suggested a change in the title; which resulted in ‘confuse space’ to be used. Expert three also suggested that the definition should reference the opposition player; therefore, “movement around an attacking player” was added to the definition. Following these changes, in round three, the new tactical behaviour confuse space achieved an improved I-CVI score of 1.0 (100% agreement) and was now ranked as the fourth equal (out of nine) for the most important tactical behaviours creating turnovers on defence.

Table 6: Example of suggested amendments for the continuous movement tactical behaviour

Version one definition	Suggested amendments	Version two definition
Continuous movement: The actions of players to create the illusion that spaces on court are covered.	<p>Expert 2: “Perhaps try “creating the illusion that spaces on court are available””</p> <p>Expert 3: “The actions of players to create the illusion that spaces and or opposition players on court are covered”</p> <p>Expert 4: “Continuous movement sounds frenetic, sometimes in defence I would want the illusion that there is space to pass the ball for the purpose of intercepting”</p> <p>Expert 6: “Preference here would be “con to create” with definition being smart movement of players to create gains”</p> <p>Expert 8: “Change continuous movement to confuse space or contest ball”</p>	<p>Confuse space: Varied movement around an attacking player to open or close the space they have available to receive a pass</p>

In another example, the attacking tactical behaviour, holding, achieved an I-CVI score of 100% agreement in round two; however, it was ranked as the least important tactical behaviour. The expert amendments were used to re-write the definition and title. As shown in Table 7 below, many of the experts suggested adding “to receive a pass”; therefore, an addition to the definition was made which read, “to show a clear space to receive a pass for yourself or another player”. Expert six also raised concern about the title (holding), as it could be considered as an illegal action in netball. A more passive title of protect space was put forward, which was included in the initial definition. In round two, the definition maintained an I-CVI score of 1.0 (100%

agreement), and, while it remained as a low ranked behaviour (8th out of nine), the authors agreed that it would remain in the TPG.

Table 7: Example of suggested amendments for the 'holding' tactical behaviour

Version one definition	Suggested amendments	Version two amendments
Holding: The ability of the attacking player to use their body to protect space.	<p>Expert 3: "To receive a pass"</p> <p>Expert 4: "Protect space in which to receive a pass or protect for a team mate to receive a pass i.e. screen"</p> <p>Expert 6: "The ability of an attacking player to use their body to show a clear space for passer. I am slightly concerned at this one as internationally we have been getting a lot of umpiring calls against us due to our technique of "holding"".</p> <p>Expert 8: "The ability of any player to use their body to protect or create space for self or others"</p>	<p>Protect Space: Using the body to create and show a clear space to receive a pass for yourself or another player</p>

In summary, the expert responses from the questionnaire in Delphi round two, informed many changes to version one of the TPG including; 14 re-written tactical behaviour definitions, 5 title changes, and 8 deleted tactical behaviours. Five of the deleted definitions included the attacking tactical behaviours continuous movement, penetration and reset, and the defensive tactical behaviours were court coverage and isolate. These five tactical behaviours were ranked low (9th= place or lower) in round one and, while they could have been re-written, a decision was made to exclude them, as many of definitions remaining in the TPG already captured the concepts the behaviours were attempting to define. In addition, role clarity, communication and player tendencies were removed from the list of definitions. While these three behaviours were considered important, upon reflection the researchers viewed them more as foundational concepts underpinning all tactical behaviour and were, therefore, removed.

In round three, three minor changes to the definitions were made; however, it was agreed upon by the research team that these changes did not alter the meaning of the definition in any significant way, and it was unanimously agreed that a fourth Delphi round was not needed to confirm definition agreement.

Version three: The final version of the TPG

The final version of the tactical principles guideline in Figure 7 includes 18 tactical behaviour definitions (nine attacking behaviours and nine defensive behaviours), and four overarching tactical principles including; i) Space and movement, ii) Timing, iii) Support and iv) Reading play. The reduction of six tactical principles to four was informed by the changes made to the tactical behaviour definitions. The team cohesion tactical principle was removed following the removal of all of the tactical behaviours it categorised including; role clarity, communication and player tendencies. In addition, the deception tactical principle was removed following the removal of the defensive tactical behaviour isolate. The attacking tactical principle draw and fake was originally categorised in the deception principle, but was re-organised into the space and movement principle. The full list of definitions can be found in Appendix E.



Figure 7: Final version of the tactical principles guideline (TPG)

4.6 Discussion

The primary aim of this study was to use expert knowledge to develop a clear understanding of the tactical behaviours that contribute to turnovers in netball. Furthermore, the study aimed to expand upon the context deficient notational measures currently being used in elite level netball (Mclean et al., 2019). Following three rounds of consultation with netball experts, four tactical principles were identified, and consensus was reached for 18 tactical behaviours which formed the tactical principles guideline (TPG). In line with current research trends in performance

analysis, the tactical behaviours in the TPG adopt a holistic approach to describe why or how turnovers occur in netball, revealing a complex system of behaviour capturing a broader scope of tactical intentionality (Mclean et al., 2019). The four tactical principles included in the TPG and the associated tactical behaviours are discussed below. This discussion will begin with reading play as a logical start point as this principle reflects the perceptual-cognitive behaviours needed to attend to environmental information. The space and movement and timing principles will be discussed next to describe how players use environmental information to act (manipulating space and time); finally, the support tactical principle will be explained to provide an overview for how tactical behaviours are used by teams to operate as a unit.

Reading play

The tactical principle reading play is closely linked to decision making as the ability to perform the right action at the right moment, requires players to 'read the game' and react with an appropriate response (Elferink-Gemser et al., 2010). The concept of reading play has been heavily researched in the team sport literature, where references to the perceptual-cognitive aspects of attention, pattern recall, and anticipation have been shown to be determining factors in sporting expertise (Farrow, 2010). The identification of the reading play principle by the experts in this current study is corroborated by the identification of a similar concept of 'spatial awareness' in the work conducted by Mclean et al. (2019). Spatial awareness was not specifically defined in the Mclean et al. (2019) research; however, in this current study, the tactical behaviour space awareness was defined for both attack and defence. For attacking players, space awareness relates to one's ability to read spaces to move into or pass to. On defence, space awareness is concerned with the ability to read the spaces attacking players want to use, to stop them.

Space and movement and Timing

The space and movement and timing tactical principles represent a variety of actions that players enact to solve tactical problems on court. Space and time represent two key constraints in team sports, as players must navigate different spatiotemporal barriers to maintain possession and score on attack, and prevent scoring and regain possession on defence (Grehaigine et al., 1997). The tactical behaviours identified in the space and movement and timing principles define how players can create affordances

for their teammates or create unpredictability for their opponents. The importance of these behaviours is reflected in the results of this current study as the experts identified the attacking tactical behaviours; decisive movement, getting free and protect space as the most important behaviours for preventing turnovers and decisive movement as the most important defensive tactical behaviour for creating turnovers.

The timing tactical principle is analogous to the concept of ‘controlling momentum’ identified in the study conducted by Mclean et al. (2019). In their study, controlling momentum was defined as “the ability to slow down or speed up play as the match situation demands” (Mclean et al., 2019, p. 9). The expert coaches in this present study, were able to expand on this concept and explain the potential mechanisms that players use to control momentum in netball. For example, the attacking tactical behaviour pace of the ball, explains how the varied use of timing (release of the pass on the 1st, 2nd or 3rd second) or the type of pass (a fast-flat pass compared to a slow lob pass), can create unpredictability and thus disrupt the defensive teams attempts to gain a turnover. In addition, the defensive tactical behaviour delay and disrupt ball offload, defines how defensive players can influence momentum through disrupting the attacking players vision and slowing down the release of a pass.

Support

The final tactical principle is support, which describes how players support each other to reach performance goals (i.e., gaining turnovers and maintaining possession). The support principle is prevalent in all ‘passing-catching’ dyads in netball, as the player in possession of the ball is constrained by the rules of the game (not being able to move and having to pass the ball within three seconds). Therefore, the passer becomes reliant on their teammates to create passing affordances (creating options to pass the ball). For the defensive team, the support principle identifies how players work as a cohesive unit to create turnovers. The scenario in Figure 8 below, provides an example of the support principle, and specifically the tactical behaviour; defensive unity. In image A, in Figure 8, the scenario shows the goal keep (GK) moving away from her opposition partner, leaving the goal shoot (GS) unmarked (as shown in arrow one). As a reaction, the GD moves into the goal circle (as shown by arrow two), to defend the GS. This movement, is an example of defensive unity, and explains how defensive teams maintain a unit structure or re-stabilise balance to provide support or cover for their teammates.



Figure 8: Example of the support tactical behaviour; defensive unity

As shown in image B, Figure 8 above, the pass is released to the GS and is subsequently intercepted by the GD. While this turnover was gained by the GD, the intercept affordance was created from the actions of the other defensive players. In addition to the movements of the GK, the ball carrier is also being guarded by two defensive players; wing defence (WD) and centre (C) who are delaying and disrupting ball offload, (as shown in image A, Figure 8. This tactical behaviour disrupts the passer's vision and slows down the release of the pass, allowing the GD more time to read play. This example highlights that turnovers are the result of multiple interacting players, using a variety of tactical behaviours. While the GD in Figure 8 still had to use individual tactical behaviours, such as attack the line of the ball and contest catch space, the opportunity to gain a turnover would not have been there, if not for the actions of the other defensive players.

4.7 Conclusion

The Delphi method used in this study has prioritised the expert voice, allowing for the development of clear and concise definitions of tactical competency in netball. A priority for future research is to understand the complex interactions that occur between these tactical behaviours to better understand how to create winning performances in netball (Araujo et al., 2006). If future research is able to identify the

factors that differentiate successful and unsuccessful teams, specific training for particular tactical behaviours can be prioritised and incorporated into training (Farrow, 2010).

4.7.1 Practical applications

While it is important to assess individual behaviour in team sport, we recommend that tactical behaviour must be understood in the context of the team. Therefore, when using game statistics to assess performance (i.e., individual statistics which show the number of passing errors or intercepts a player has), it is important to acknowledge that those errors or successes are the result of the interactions of multiple players on court, and not solely a reflection of that player's tactical ability. The tactical behaviour definitions developed from this study have been incorporated into Netball New Zealand's player profiling tool, using the four tactical principles, space and movement, timing, support and reading play to assess player competency. The definitions in the TPG, allow for the exchange of ideas through a shared vocabulary and, therefore, can be used to increase the quality of communication between coaches and players. The continued development of the TPG will create a strong foundation from which to enhance tactical development and game analysis in netball. As a first step, further research is needed to determine if netball experts (coaches) are able to identify the tactical behaviours in the TPG in real game contexts, and specifically identify the complex relationships these tactical behaviours have to turnovers in netball.

Chapter 5 Understanding the tactical behaviours associated with turnovers in elite netball

This chapter comprises of the journal article submitted for publication in the Journal of Sport and Exercise Science.

Abstract

Objective: The primary objective of this study was to identify why turnovers occur in netball. In a previous study, the Tactical Principles Guideline (TPG) was developed using a group of expert netball coaches. In the development of the TPG, the expert coaches defined 18 tactical behaviours (nine attacking and nine defensive behaviours), that can explain why turnovers occur in netball. Despite the tactical behaviour definitions being rated as content valid in the initial study, further research was needed to determine if a second group of coaches were able to identify the tactical behaviours in real game contexts. **Methods:** Ten expert netball coaches responded to an online questionnaire which required them to review 10 turnover scenarios. Each coach used the TPG to identify the tactical behaviours that contributed to causing or creating the turnover, as well as which players were involved in the turnover. **Results:** All 18 tactical behaviours in the TPG were identified and used to explain why turnovers occur in netball. The results also show that turnovers are the result of multiple players using a variety of different tactical behaviours. **Conclusion:** Unlike traditional notational analyses the TPG is able to identify that turnovers are the result of multiple interacting players. Therefore, this study has taken a step further in validating the TPG as an effective tool for understanding turnovers in netball.

Key words: Team sport, Invasion games, Game analysis

5.1 Introduction

In team sports there is a constant demand for players to collectively respond and react to uncertainty in the performance environment (Silva et al., 2013). These demands create an environment where players are presented with a multitude of tactical problems to solve (Grehaigine et al., 1997). Tactical problems include how to maintain possession and score during offensive (attacking) phases, and how to regain possession and prevent scoring during defensive phases (Gutierrez et al., 2011). The ability to solve

these tactical problems has been shown to be indicative of success in team sports (Grehaigine et al., 1999).

In order to understand team sport success, it is important to recognise team sports as complex adaptive systems (Chow et al., 2006). This complexity can be observed in the antagonistic relationship between opposition teams as they produce examples of self-organising behaviour. This constant battle between teams creates a game that flows between states of stability (stable patterns of behaviour), instability (unstable patterns of behaviour) and phase transitions (changes in the organisation of the team) (Vilar et al., 2012a). For example, in situations where the ball changes possession from one team to another, a phase transition occurs, which creates moments of disorder that can be capitalised on to gain advantage over the opposition and create scoring opportunities (Garganta, 2009).

The coordination of team behaviour is critical during these unstable, transitional periods of play that occur when there is a change in possession or a disruption in the flow of the game. Therefore, the ability to collectively exploit environmental resources to make decisions that afford action becomes indicative of good team performance (Gesbert et al., 2017). When an affordance or 'opportunity to act' is perceived, the subsequent actions performed are the realisation of that affordance (Araujo et al., 2006). Whether the affordances are acted upon effectively or not, the observed actions provide valuable information regarding a player or team's tactical competency. At the interpersonal level, players can be perceptually attuned to affordances *for* and *of* others. The ability to perceive affordances for others requires that an athlete is able to accurately assess what actions are possible for a teammate or opposition player. Perceiving affordances of others, is the ability to act upon the opportunities others have created (Fajen et al., 2008).

Many invasion sports are well suited to understanding complex tactical behaviours that occur during turnovers. This paper will focus on netball, a seven-a-side court sport, similar to basketball. In netball, the seven team members are allocated a position, each with different roles and positional court restrictions. For example, the primary role of the 'goal shoot' (GS) is to shoot goals, while being restricted to playing in one third of the court. The main role of the centre (C) is to restart the game after every

goal is scored (from a centre pass in the middle of the court) and act as a link between the attacking and defensive positions to move the ball through the court. The C is allowed in all three thirds of the court, but not inside the shooting circles. Netball also has a set of rules that differentiate it from basketball. Firstly, when a player is in possession of the ball they cannot move (more than one step), and they must dispose of the ball (pass to a team mate or shoot a goal) within three seconds of receiving the ball. Defensive players must not 'defend' or have their arms up defending a player if they are within 0.9m of a player in possession of the ball. In addition, unlike basketball, a defender may not 'contact' another player (INF, 2016).

Current methods for exploring the processes that lead to turnovers in netball are grounded in the use of notational techniques that denote observable sequences of behaviour to describe "who-did-what-where-when" (Vilar et al., 2012a, p. 2). These methods rely on coaches and/or game analysts to observe the unfolding patterns of game behaviour and then record the discrete actions that occur, such as the passing sequences between players, or the nature of turnovers (Alexander et al., 2019). The most common type of turnover in netball is probably 'passing and catching errors', which account for most losses in possession (according to unpublished notational analysis data). Passing and catching errors occur when the ball is lost in the transition between two players as they attempt to move the ball through the court. When using notational methods, these errors are coded by identifying the attacking player who threw the pass and the defensive player who gained the turnover.

Within the team sports literature, there has been a focus on passing and catching errors, with particular interest in the frequencies and percentages of observable behaviour for the player in possession of the ball (McGarry, 2009; Sarmiento, Campanico, & Leitão, 2010). O'Donoghue et al. (2008) provided data highlighting the performance indicators that differentiate between 'top of the table', and 'bottom of the table' netball teams, showing that 'top of the table' teams, create, and score from a greater percentage of turnovers, compared to teams at the bottom of the table. However, little detail was provided as to why or how these turnovers occurred. In a recent netball study, Bruce et al. (2009), looked specifically at the cause of passing errors by classifying the error as being 'within reach' or 'out of reach' of the intended receiver. The inter-rater agreement for the categorisations of 'within reach' and 'out of

reach' passes was very high ($k=0.90$), and significantly more passing errors were classified as 'within reach', compared to passes that were 'out of reach'. Such results suggest that even when a pass is thrown within reach of the intended receiver, errors still occur. At present the role of the intended receiver in causing passing errors (or other attacking players), has not been well explained.

The classification of passing errors using observational methods has been regarded as a gold standard for assessing tactical behaviour (Rein & Memmert, 2016). However, as such methods (e.g., notational analyses) are descriptive rather than explanatory, they cannot identify the causative mechanisms and processes underpinning the error, or why it occurred (McGarry, 2009). Recently, alternative methods for analysing game complexities and tactical performance have been proposed. Computer aided technologies such as GPS (Sampaio & Macas, 2012), self-organising maps (Croft et al., 2018), and video based time-motion analyses (Carvalho & Gonçalves, 2017) have been used to track the movements and positional organisations of players. While these technological innovations are valuable, they still require human input to specify which performance variables to track to produce meaningful data.

A more common approach in the literature to understand why turnovers occur is the manipulation of task constraints in small-sided games to identify patterns of successful behaviour (Moreira Praça et al., 2018). For example, the number of players involved in a game can shape the emergence of different individual and collective tactical behaviours (Ometto et al., 2018). In football, when team numbers are manipulated to create numerical inferiority for the defensive team, defenders have to account for the extra attacking player, which has been shown to promote high coupling between defending players (Travassos, Vilar, Araujo, & McGarry, 2014). As a result, defensive players have been shown to restrict the space between themselves and re-organise to protect the goal (Travassos et al., 2014; Vilar et al., 2012a). Praça, Costa, Costa, Andrade, and Greco (2016) also found that in contexts of defensive inferiority, higher frequencies of 'defensive unity' were identified, suggesting that to combat the additional player, defensive players adapt and react as a unit to overcome their disadvantage.

In a recent study (in chapter four), the tactical principles guideline (TPG) for netball was created. The TPG was developed using the Delphi method to gather knowledge from 10 expert coaches to create a list of key tactical behaviours that contribute to turnovers in netball. Following three rounds of interview and questionnaire, a list of 18 tactical behaviour definitions were developed and refined, until the required level of agreement was reached. As shown in Figure 9 below, a total of 18 tactical behaviours are included in the TPG, with nine attacking tactical behaviours, and nine defensive tactical behaviours. These tactical behaviours are categorised into four tactical principles; space and movement, timing, support and reading play.



Figure 9: Tactical Principles Guideline

In developing the TPG, netball experts identified a variety of actions used by individuals and teams to create or prevent turnovers in netball. The TPG includes behaviours that occur both 'on' and 'off' the ball. On-the-ball behaviours refer to the actions of players in possession of, or guarding the player in possession of the ball, whereas off-the-ball behaviours occur away from the ball carrier (Oslin et al., 1998). For example, for the player in possession of the ball (on-the-ball), option selection and space awareness are tactical behaviours used to determine whom to pass the ball to, and where to pass the ball. In addition, protect space, decisive movement, and getting free are tactical behaviours that off-the-ball attacking players use to create good quality informational cues for the passer to read and decide where, when and whom to pass

the ball to. Therefore, rather than turnovers being identified as the passer's error, the TPG can potentially be used to help identify the contributing role that other attacking players have in the turnover. At present, the TPG has not been used in real game contexts, and further investigation is needed to determine if a second group of coaches are able to identify these tactical behaviours in game footage, and use them to describe why turnovers occur in netball.

Therefore, there are two aims of this current study. The primary aim is to determine whether a group of coaches can identify the tactical behaviours in the TPG in real game contexts. If these coaches are able to identify the tactical behaviours in the TPG, then the second aim can be addressed; which is to determine if the TPG can be used to effectively explain why turnovers occur in netball. Following these aims, two research questions will be addressed; Are the tactical behaviours in the TPG identifiable? Why do turnovers occur in netball? As a result, it is hoped to gain a greater understanding of the complexity of turnovers in netball to expand upon what we know from traditional notational analysis. The ethical approval confirmation, information sheet, and consent form is included as Appendices G, H, and I.

5.2 Methods

5.2.1 Participants

A purposeful sample of expert netball coaches were invited to participate in this research. The invited coaches held various high performance coaching roles within Netball New Zealand. A total of 21 coaches were invited, and 10 coaches agreed to participate in this study. Five of the invited participants could not participate due to unavailability at the time of data collection and six coaches did not respond.

5.2.2 Procedure

Prior to commencing the study, the coaches were sent a copy of the TPG to become familiar with. The coaches were then sent an email from the lead author that contained a link to complete the study via the online platform Qualtrics (Qualtrics, 2015, Provo, UT). For the study, the coaches were presented with sequences of game footage showing the unfolding events of 10 different turnovers in netball. Each scenario was between 6-17 seconds long ($M=10.7$ seconds, $SD=4.06$). After observing each scenario, the coaches were instructed to respond to four questions. The questions required the

coaches to; a) identify the players involved in the turnover, b) identify the tactical behaviours they observed in the turnover (using the TPG), c) identify which players were using the identified tactical behaviours, and d) rank each player's importance for creating or causing the turnover (1=most important, 7=least important). The 1-7 scale represents the seven players in a netball team, therefore, the player ranked 1st was the most important for creating or causing the turnover, and the player ranked 7th was the least important player. If there were four players selected (as shown in Figure 10 below (image A), then the ranking would be from 1-4). Figure 10 below provides an example of the visual display accompanying the four questions that the coaches responded to for one team.



Figure 10: Overview of questions the coaches responded to A: Select players involved, B: Select the tactical behaviours you observed C: Select which players used which behaviour, D: Rank the players' involvement

As shown in Figure 10 when answering questions A, C and D, the coaches were provided with a still image from the video, showing the moment (frame) immediately prior to the final pass being made. For question A, the coaches were able to click directly onto the image and select the players who were involved in the turnover, and for questions C and D, the image was used as a prompt to aid recall of the scenario. The

coaches were instructed to identify tactical behaviours observed in the whole scenario, not just the moment within the still image. For question B, the coaches were asked to select the tactical behaviours they observed. If the coaches observed a behaviour that did not represent any of the tactical behaviours in the TPG, the coaches were able to select 'other' and provide a description of what they observed.

5.2.3 Data Analysis

The first research question; are the tactical behaviours in the TPG identifiable? was addressed by reporting the raw frequencies that each tactical behaviour was identified across all 10 scenarios, from all 10 coaches. In addition, the second research question; why do turnovers occur in netball? was addressed with three stages of analysis outlined below.

Stage one: Number of players and tactical behaviours identified

Stage one determined the number of defensive and attacking players involved in creating or causing the turnover, as well as the number of different tactical behaviours involved. Means and standard deviations were calculated for the number of players and number of behaviours involved in each turnover (for attack and defence). Cohens D effect sizes (d) (Fritz, Morris, & Richler, 2012) were reported to determine if there were any differences between the attacking and defensive teams for the number of players and the number of tactical behaviours involved in the turnover. Cohens D was calculated using the mean difference between the attacking and defensive measures divided by the mean standard deviation.

Stage two: Rank analysis results

Stage two identified which players (from most important to least important) had a role in creating or causing the turnovers. In order to mimic traditional notational analysis, this analysis focussed on the three players who are typically associated with turnovers; the passer, the intended receiver and the interceptor. For each turnover, the passer, intended receiver, and interceptor, were identified and the number of times they were ranked as the most important player for causing or creating the turnover was recorded and reported.

Stage three: Scenario analysis

As a final stage of the analysis, the researchers selected one turnover from the study to further explore the coach responses in depth to outline the processes underpinning the turnover.

5.3 Results

Research question one: Are the tactical behaviours in the TPG identifiable?

As shown Table 8 and Table 9 below all 18 tactical behaviours (9 attacking and 9 defensive behaviours) were observed by the expert coaches. The total observations show that each tactical behaviour was observed between 73-421 times in total across the 10 scenarios.

Table 8: Total frequency of observations for the defensive tactical behaviours

	Confuse space	Attack line of the ball	Contest catch space	Dictate movement	Delay and disrupt ball off-load	Defensive unity	Full team defence	Reading patterns	Space awareness
Coach 1	50	8	8	52	9	53	0	41	43
Coach 2	2	6	4	9	1	11	14	5	7
Coach 3	38	41	42	50	46	51	48	50	43
Coach 4	40	8	5	48	26	58	37	21	40
Coach 5	13	8	7	29	7	44	22	6	12
Coach 6	18	3	3	40	8	36	12	8	13
Coach 7	1	5	3	25	22	35	14	2	6
Coach 8	17	5	3	17	14	36	6	17	2
Coach 9	20	4	7	50	11	54	45	52	44
Coach 10	35	6	20	14	21	43	6	0	10
Total	234	94	102	334	165	421	204	202	220
SD	16.6	11.2	12.3	16.6	12.9	13.7	17.1	20.2	17.9

Table 9: Total frequency of observations for the attacking tactical principles

	Protect space	Court balance	Decisive movement	Draw or fake	Pace of ball	Getting free	Options to the ball	Option selection	Space awareness
Coach 1	24	20	23	28	10	24	26	9	22
Coach 2	1	4	4	4	2	5	8	10	4
Coach 3	39	32	40	42	28	35	40	44	43
Coach 4	38	16	40	37	14	37	44	14	19
Coach 5	12	5	11	1	6	10	17	8	9
Coach 6	11	6	16	5	2	7	29	10	9
Coach 7	3	7	7	2	2	6	12	8	8
Coach 8	8	5	9	2	6	14	17	3	6
Coach 9	6	35	33	4	0	28	35	10	27
Coach 10	7	9	16	7	3	24	30	16	2
Total	149	139	199	132	73	190	258	132	149
SD	13.9	11.6	13.5	15.9	8.4	12.1	12.1	11.4	12.8D

The large range in the frequency of observations, as shown in Table 8 and Table 9 above (73-421), is representative of the number of players likely to use each tactical behaviour in a given scenario. For example, the defensive tactical behaviour 'defensive unity' was observed 421 times across the 10 scenarios. This large number of observations can be explained logically, as defensive unity requires the presence of multiple players working together. In contrast, the tactical behaviour 'attack the line of the ball' (ALOB) was observed only 94 times. Unlike defensive unity, when ALOB is observed, it is logical to assume that only one or two players per scenario would use this behaviour in the attempt to gain an intercept.

It is also important to note that there were three different tactical behaviours that were not identified by one coach (a different coach for each behaviour). As shown in Table 8 above, coach one did not identify full team defence in any of the scenarios, and coach ten did not identify reading patterns in any of the scenarios. In addition, as shown in Table 9 above, coach nine did not identify pace of the ball in any of the ten scenarios.

Research question two: Why do turnovers occur in netball?

Stage one: Number of players and tactical behaviours identified

On average, the coaches identified 4.86 ($SD=1.18$) defensive players involved in creating each turnover, and 3.96 ($SD=1.40$) attacking players involved with causing the turnover. The difference between the defensive and attacking team was 0.9 players, with a medium effect size of $d= 0.70$ (Fritz et al., 2012). When creating or causing the turnovers, the coaches identified the defensive team using an average of 5.68 ($SD=1.97$) defensive tactical behaviours per scenario, and an average of 5.58 ($SD =2.37$) attacking tactical behaviours per scenario. The difference between the defensive and attacking teams was 0.1 tactical behaviours, with a low effect size of $d=0.04$. See Table 10 below. Therefore, there was no meaningful difference between the number of tactical behaviours used to create the turnover.

Table 10: Number of players and number of tactical behaviours involved in the turnovers

	Defensive team (D)	Attacking team (A)	Mean difference: (D-A)	Effect size (d)
Mean number of players involved (SD).	4.86 (1.18)	3.96 (1.40)	0.9	0.70
Mean number of tactical behaviours involved (SD)	5.68 (1.97)	5.58 (2.37)	0.1	0.04

Stage two: Rank analysis results

Defensive players: Seven of the ten scenarios included an intercept. In these intercept scenarios, the player who intercepted the ball was ranked as the most important player for creating the turnover 52.2% of the time (36 out of 69). This result suggests that while the interceptor was seen to be important, the other defensive players were also seen to contribute equally to creating turnovers. This is a more sensitive approach than traditional notational analysis in which 100% of intercept turnovers are coded as a 'gain' for the interceptor without acknowledging the impact of the other six players on the court.

Attacking players: In the ten scenarios where a passing error occurred, the passer was ranked as the most important player for causing the turnover 72% of the time (67 out of 93 ratings). The intended receiver was ranked as the most important player 20% of the time (17 out of 85 ratings), and finally the other attacking players

were ranked as the most important players 11% of the time. While the passer was ranked as the cause of the turnover most often, the coaches did recognise the contribution of the “other” attacking players, not just the passer and intended receiver. These results will be explored further in stage three below.

Stage three: Scenario analysis

The next stage of the analysis adopted a flexible method to report the different tactical behaviours that were identified by the coaches when explaining why turnovers occur. In this study the ‘flexible method’ refers to taking an investigative, qualitative approach where one scenario was used as a case study. This approach was necessary as every turnover is different and while patterns may emerge in different scenarios, the specific combinations of tactical behaviours used differ for each turnover, in terms of who was involved and what they did to contribute to the turnover. The scenario being used for this stage of the analysis is shown in Figure 11 below. In this scenario, the wing attack in red (WA) is about to pass the ball to the goal shoot in red (GS). As the pass is released, the opposition goal keep (GK) (in black) runs out and intercepts the pass. Using traditional notational analysis, the passing error made by the WA would be recorded as a ‘loss’ for the WA, and the resulting intercept would be recorded as a ‘gain’ for the GK. However, when using the TPG, the coaches in this study were able to further explore why the turnover occurred through identifying multiple players using a variety of tactical behaviours. The specific tactical behaviours identified in this scenario, for the attacking and defensive team are discussed below.



Figure 11: Scenario example resulting in an intercept

Attacking team

In the scenario shown in Figure 11 above, the coaches identified four attacking players (in red) as causing the turnover; wing attack (WA), goal shoot (GS), goal attack (GA) and centre (C). As shown in Table 11 below, all 10 coaches identified the attacking tactical behaviour option selection for the WA, suggesting that she made a bad decision about whom to pass to. Seven of the ten coaches also selected the tactical behaviour draw and fake, suggesting that if the WA had attempted to 'fake' the pass in one direction, then pass in a different direction, the turnover may not have happened. The coaches also recognised the role that the GS, GA and C had on contributing to the passing error. For these players (GS, GA & C), the tactical behaviours, decisive movement and options to the ball were identified most often, highlighting that the GA and GS did not drive strongly and clearly to the ball (decisive movement) and the GA and C did not present themselves as viable passing options (options to the ball).

Table 11: Attacking players involved in the turnover and attacking tactical behaviours identified

Number of experts who identified the player		Tactical behaviours identified (and the number of coaches)
WA (passer)	10/ 10	Option selection (10/10), Draw & fake (7/10)
GS (receiver)	8/ 10	Decisive movement (6/8)
GA	8/ 10	Decisive movement (6/8), Options to the ball (6/8)
C	7/ 10	Options to the ball (6/7)

While the WA threw the pass that was intercepted, her options were limited by the ineffective positioning and movements of her teammates. The GA, GS and C were unable to communicate clearly where they wanted to receive the pass, forcing the WA to make a poor decision, resulting in the turnover. The results from this example scenario reflect the most common results from all other nine scenarios, as option selection was the most frequently identified tactical behaviour for the passer and decisive movement and options to the ball were the most frequently identified tactical behaviours for the other attacking players.

Defensive team

For the scenario in Figure 11 above four defensive players (in black) were identified as creating the turnover; the goal keep (GK), goal defence (GD), wing defence (WD), and centre (C). As shown in Figure 11 above, the GK (interceptor) was identified by all 10

coaches as being involved in the turnover. The coaches identified the tactical behaviours, attack the line of the ball, confuse space, defensive unity and space awareness as the tactical behaviours the GK used to intercept the ball.

Table 12: Defensive players involved in the turnover and the defensive tactical behaviours identified

Number of experts who identified the player		Tactical behaviours identified (and the number of coaches)
GK (interceptor)	10/10	Attack the line of the ball (9/10). Confuse space (7/10), Defensive unity (8/10), Space awareness (6/10).
GD	10/10	Confuse space (8/10), Defensive unity (8/10), Delay and disrupt (7/10)
WD	9/10	Dictate movement (6/9), Defensive unity (7/9)
C	10/10	Delay and disrupt (7/10), Defensive unity (7/10), Dictate movement (6/10)

The other defensive players, GD, WD and C, were also identified as playing a role in the turnover. The defensive tactical behaviours that were identified most often included dictate movement, defensive unity, confuse space, and delay and disrupt ball off load. The defensive tactical behaviour, dictate movement is shown in the scenario (Figure 11), as the attacking players (WA and C), are pushed very wide, which is not considered the best position to pass into the goal circle. Therefore, the defensive players (WD and C) were able to dictate their opposition into ineffective spaces on the court, and shut them down as potential passing options. The GD and GK were identified as confusing space, as their movements made it difficult for the passer (WA) to know which players were free to pass to. The C and GD also used delay and disrupt ball off-load, which can be seen being performed by the player defending the ball carrier, with their arms up, making it difficult for the passer (WA) to clearly see where to pass the ball. These actions forced the WA to make a pass that was easy for the GK to read, using space awareness to make the decision to attack the line of the ball and contest catch space to gain the intercept.

5.4 Discussion

This study aimed to answer two primary research questions to determine the effectiveness of the TPG for understanding turnovers in netball. The first question aimed to identify whether the tactical behaviours in the TPG are identifiable in turnover

scenarios. The results highlight that all 18 tactical behaviours were detected in the turnovers, and thus were considered 'identifiable'. In total, the tactical behaviours from the TPG were observed 3,397 times by the expert coaches to explain 'why turnovers occur' and thus we can answer the first research question, and conclude that all the tactical behaviours are identifiable. To further strengthen this finding, it was notable that the expert coaches only selected the 'other' option three times. This finding provides support for the overall content validity of the TPG as the tactical behaviours in the TPG are able to describe the tactical events observed in each turnover without any additions or modifications (Heale & Twycross, 2015).

The second research question was used to gain deeper insight into why turnovers occur in netball? One of the key results was that the coaches in this study were able to identify multiple players, using different combinations of tactical behaviours to explain why turnovers occur. On average, across the 10 scenarios, the coaches identified more defensive players (4.86 players) involved in the turnovers compared to attacking players (3.95 players), suggesting that when defenders create numerical superiority (more defensive players than attacking players), they may be more likely to gain a turnover.

As shown in previous studies, in small sided-games, researchers deliberately alter the number of players in a team to manipulate the tactical behaviours used. In football, Praça et al. (2016) found that in contexts of defensive inferiority, higher frequencies of 'defensive unity' were identified, suggesting that to combat the additional attacking player, defensive players adapt and react as a unit to overcome their disadvantage. In addition, Travassos et al. (2014) showed that numerical inferiority for the defensive teams is associated with decreased distance between defensive players, as they converge and retreat to protect the space in front of the goal.

Although this present study did not specifically manipulate the number of players involved in the turnovers, there are moments within the scenarios where numerical superiority or inferiority can be observed. For example, Figure 12 below shows one of the scenarios used in this present study. In this scenario the player in possession of the ball (C) is unmarked (i.e., there is no defender in immediate proximity). This leaves the five defensive players (GD, WD, C, WA, GA, shown in the red

squares), marking four attacking players (WA, GA, GD, WD, in the yellow dresses, who are legally able to receive the ball); that is, the defensive team has numerical superiority, placing the C under more pressure to make the decision of whom to pass to. In this scenario, the C is forced to pass to the WD, and the ball is intercepted by the GA.



Figure 12: Scenario example, which resulted in the black team (GA) intercepting the ball.

While creating moments of numerical superiority is important, the results from this study also highlighted that we need to understand the tactical behaviours that players use to create or prevent turnovers. The tactical behaviour option selection was most frequently recognised as the cause for turnovers for the passer. However, from an ecological dynamics perspective, decision making (or option selection) is not derived solely from an individual's (passers) thoughts and perceptions; rather, it involves a complex interplay between the performer's perceptions, cognitions, and actions, within the nuances of their performance environment (Araujo et al., 2015). The detection of affordances (opportunities to act) requires that the passer is attuned to the relevant environmental information to guide their decision-making; however, successful attunement depends on the quality of information available (Correia, Araujo, Craig, & Passos, 2011). Grehaigne et al. (1997) referred to this as 'problems related to information' and noted that it is the duty of the prospective passing options to reduce uncertainty and create good quality information for the passer to attend to and use (Grehaigne et al., 1997).

This notion of the quality of information was identified in the results of this current study, as the coaches were able to identify that attacking players (other than the passer) were partly responsible for the turnovers occurring. The attacking players (other than the passer) were ranked as the most important players for causing the turnover 28% of the time. Although this is relatively low, it is an important first step in recognising that passing errors are not solely caused by the passer. The results highlighted the different tactical behaviours that attacking players use to increase the quality of information to the passer. Particularly, the tactical behaviours of decisive movement, options to the ball, protect space and get free. These results are corroborated by the earlier study in chapter four as these four tactical behaviours were rated as the most important for preventing turnovers on defence by a different group of experts.

The coaches in this present study also identified a variety of defensive tactical behaviours that can create uncertainty for the attacking team. For example, when defensive players dictate movement and confuse space they are able to control or condense the space that attacking players have to use, limiting the options the attacking player has to pass to. When the defenders work effectively as a unit and limit the passer's passing options, they increase the predictability of where the ball will be passed; therefore, other defensive players are able to more accurately anticipate where the ball will go. To gain the intercept, the potential 'interceptor' must be able to read the affordances (intercept opportunities) that are being created for them (Fajen et al., 2008). The coaches in this study also identified the defensive tactical behaviours, attack the line of the ball, and contest catch space for the player who eventually intercepts the ball, suggesting that once the affordance has been created, the player still needs to work hard to be in the right position to ensure they can intercept the ball cleanly (without a penalty).

5.5 Conclusion

Despite the criticism that notational methods have received in the literature, they remain the most frequently used tools for assessing team performance in team sports such as netball. This current research has built upon notational methods, to highlight the wider contextual factors that influence turnovers in netball. Specifically, this research has shown that turnovers are the result of multiple interacting athletes, using

a variety of tactical behaviours to create or cause turnovers. The TPG appears to be an effective tool that coaches can use to identify tactical behaviours which contribute to turnovers in netball. As the TPG is still in the development phase, more research is needed to determine its effectiveness outside of video based protocols. For example, the TPG could be used to design training tasks that manipulate certain tactical principles, to help players create turnovers on defence, and prevent turnovers on attack. This knowledge can enhance the impact that coach-led interventions can have on the development of tactical skill and overall team success (Clemente et al., 2013).

5.6 Practical applications

Based on the results from this study, we recommend that coaches focus on the 'supportive' behaviours that a team can do to prevent or create turnovers. For example, on attack, the tactical behaviour options to the ball was the most frequently recognised attacking tactical behaviour (a total of 258 times), suggesting that turnovers were frequently caused by the passer not having options of whom to pass to. Coaches can develop this tactical behaviour by emphasising the need to have at least three passing options at all times (to support the ball carrier)—a straight option, a square option and a backwards option. In addition, the defensive tactical behaviour defensive unity was the most frequently recognised defensive behaviour for creating turnovers (a total of 421 times). This suggests that when players work together and adjust to each-other's movements, when they are reacting to the opposition, they are more likely to gain an intercept. Coaches can develop this skill in their players through teaching a zone style defence, where players are instructed to mark 'space' rather than their direct opponent.

Chapter 6 Investigating the predictive value of the Tactical Principles Guideline (TPG) during squad selection in netball

This chapter comprises of the journal article submitted for publication to the International Sports Coaching Journal.

6.1 Abstract

In this study, the netball performance of talented players was assessed using the tactical principles guideline (TPG). Netball players (n=49) attending a development camp were rated using four tactical principles; space and movement, timing, support, and reading play. An overall tactical score (OTS) was calculated for each player to determine if differences existed between players selected into a national squad (n=17) and the remaining non-selected players (n=32). A group of 10 experienced coaches and two selectors independently rated the players. Despite the subjectivity of coach and selector assessment, the TPG had good predictive value, especially for the selectors as their OTS ratings were able to correctly identify 94% of the players selected into the national squad. In addition, a questionnaire was used to identify the coach perceptions of the TPG, showing that coaches believed that the TPG helped them identify tactical behaviour and increased their confidence to provide feedback to the players. The TPG is still in its development phase; however, these are encouraging results in terms of developing subjective methods for identifying and selecting talented youth players.

Key Words: Team selection, tactical behaviour, coach observation.

6.2 Introduction

A coach's role is multifaceted as they have an equal responsibility to identify and develop athletes to perform now, while simultaneously recruiting and retaining athletes based on their future potential (Breitbach, Tug, & Perikles, 2014). This dichotomy highlights the challenging balance that coaches, selectors and player development personnel must consider when identifying talented athletes for the future (Abbott & Collins, 2004). The prediction of long-term success is highly complex due to the variety of attributes that can affect performance such as; technical, tactical, psychological and physical skills, as well as injury status and other personal factors (Reilly, Williams, Nevill, & Franks, 2000). In the past, talent identification systems have been overrepresented by

the measurement of physical, anthropometric and technical aspects of performance. However, these factors are often influenced by biological maturation and relative age effects, making any prediction of future success difficult (Abbott, Button, Pepping, & Collins, 2005; Sieghartsleitner, Zuber, Zibung, & Conzelmann, 2019). While tactical aspects of performance have been recognised as key determinants of successful performance in team sports (Elferink-Gemser et al., 2010), there is currently limited literature that explores how assessments of tactical skill influences the identification of talented players, especially in netball.

Netball is a 7 v 7 court-based invasion sport, played mostly by women in commonwealth countries (Croft et al., 2018). While netball has many similarities to team sports such as basketball, it has its own unique rules which dictate how the game can be played. In netball, the player in possession of the ball cannot take more than one step and must pass the ball within three seconds of receiving it. In order to move the ball through the court and create scoring opportunities, netball players must work together. In contrast, in basketball, the ball carrier can dribble the ball and move freely around the court, with more time to make decisions and create their own opportunities for action. In this way, the rules of netball create a game structure where the coordination of team behaviour is critical for team success (O'Donoghue et al., 2008).

Tactical performance in team sports, such as netball, primarily consist of two components, 1) a perceptual-cognitive component (declarative knowledge) which is related to knowing what to do, and 2) the motor component (procedural knowledge), which is related to executing a motor response or doing it (McPherson, 1994). These two components, accumulated mostly through experience, guide player's decisions about when, where and how to act and react in changing situations (Cotterill & Discombe, 2016). Therefore, players with good tactical knowledge are able to use information from the environment to shape their responses to meet tactical aims (Gréhaigne et al., 2005).

Many of the research methods used to test tactical skill have focused on the perceptual-cognitive components of performance, which refer to an individual's ability to detect and process environmental cues, such as their opponent's movements (Mann, Williams, Ward, & Janelle, 2007). The expert-novice paradigm has compared various

perceptual-cognitive characteristics of expert and novice performers, demonstrating that experts outperform novices in terms of decision making, anticipation and pattern recall (Farrow, 2010; Mann et al., 2007). One issue with these studies is that decision making is usually isolated from a motor response, meaning that perception and action are not coupled or performed at the same time. For example, some studies require participants to make a verbal decision without any physical response (Gutierrez et al., 2011). This 'decoupling' of perception and action essentially decontextualises the decision-making processes observed in real games (Gutierrez et al., 2011). When participants are required to carry out a motor response, experts outperform their lesser skilled counterparts; further accentuating the experts' superiority, as they are better able to couple their decision with an accurate execution (Bruce et al., 2012b).

Research with a primary focus on the 'expert-novice' paradigm shows clear differences between athletes of vastly different skill levels (experts and novices). However, it is also valuable to differentiate between players within the expert group, which is typically required during team or squad selection (Huijgen, Elferink-Gemser, Lemmink, & Visscher, 2014; O'Connor, Larkin, & Mark Williams, 2016). For example, in team selection contexts, a large group of talented trialists must be condensed into a smaller group to make up the selected team. Therefore, assessment methods should be able to distinguish between those who were, and those who were not selected.

A study conducted by Huijgen et al. (2014), investigated the different performance traits that distinguish selected and non-selected youth soccer players and found that of the 19 different physiological, technical, psychological and tactical measures taken, three measures were able to correctly identify 69% of the selected players. Notably, one of these measures included the tactical skill of 'positioning and deciding', which captures an athlete's self-rated procedural knowledge using a series of questions from the tactical skills inventory for sports (TACSIS). In a similar study, Kannekens, Elferink-Gemser, and Visscher (2011), showed that junior footballers who scored highly in the 'positioning and deciding' section of the TACSIS, were seven times more likely to reach professional soccer levels at the age of 18 than those scoring in the lowest category (Kannekens et al., 2011).

While multidimensional testing batteries with a variety of performance variables (technical, tactical, physical and psychological) are suggested in the literature, much of the coach focused research highlights that selection processes involve little or no structured selection criteria, and rely heavily on coach intuition (Bradbury & Forsyth, 2012; Christensen, 2009). In an investigation of selection processes in high performance sport in New Zealand, Bradbury and Forsyth (2012) found that 76% of coaches rely on 'gut feel' to make decisions rather than any objective criteria, with only 28% using written selection criteria. The coaches reported that subjective qualities of performance are highly valuable; however, as they cannot be captured in any objective selection criteria, coaches are reluctant to rely on objective qualities alone (Bradbury & Forsyth, 2012). In a similar study, Johansson and Fahlén (2017) sought to identify the rationale behind different selection decisions and found that the data gathered from a variety of objectively obtained statistical measures were not formally used as a selection parameter. Rather, the measures were used as a form of 'quality control' to ensure the coaches' subjective opinions and observations were supported in some way by the objective data (Johansson & Fahlén, 2017).

The reliance on gut feel, or intuition could be considered highly problematic in elite sport, as the decision to choose one player over another can be a million-dollar decision, especially in sports such as men's football. In this way, it is important to create transparency in selection decisions. A further reason why transparency is important is the potential for inconsistencies and bias within and between different coaches or assessors. This issue was highlighted by Wiseman, Bracken, Horton, and Weir (2014) in their analysis of a group of seven coaches and two scouts (selectors) who were asked to identify a 'top five' and a 'bottom five' from a group of 13 talented ice-hockey players. From their selections, only two players were consistently identified in the 'top five', and two players in the 'bottom five' (Wiseman et al., 2014). This finding suggests that coaches and scouts (selectors) may have different priorities, which inform their selection decisions.

Contributions of sports science to team selection processes have typically focused on quantifying individual performance metrics and benchmarks to identify the 'best' players (Soltanzadeh & Mooney, 2018). However, more recent research, adopting systems based thinking, suggests that in order to better assess the individual player, we

must first understand the system (or team) as a whole (Soltanzadeh & Mooney, 2016). For a systems thinker, the identification of the 'best' player is of low priority because in order to select a team, one has to select players based on their fit within the team or sub-unit (Soltanzadeh & Mooney, 2018). Therefore, in order to assess tactical aspects of performance in individual players, selectors must consider the wider context of the selection process, and how players fit within the team.

In an attempt to create a more ecologically valid assessment of tactical behaviour, the tactical principles guideline for netball (TPG) was created in chapter four. The TPG includes four tactical principles; space and movement, timing, support and reading play; and sitting under these four tactical principles are 18 observable tactical behaviours. The tactical behaviours include nine defensive tactical behaviours such as dictate movement, defensive unity and space awareness, and nine attacking tactical behaviours such as decisive movement, options to the ball, and pace of the ball. The purpose of this present study was to determine the effectiveness of the TPG as a selection tool in a team selection context. Two measures of effectiveness were focused on. First, the discriminative power of the TPG was assessed through determining whether the ratings given to each player could differentiate between those who were selected into a national squad, and those who were not selected. A second measure of effectiveness was to determine, via a questionnaire provided to the coaches, the effectiveness of the TPG in assisting the coaches in their task of identifying tactical behaviours and whether it helped them provide feedback to their players during a one-on-one session.

6.3 Method

Research context

Data collection took place at a netball development camp. The invited attendees included 49 female, high-school aged netballers ($M=16.9$ years, $SD=0.64$), 10 netball coaches, and 2 selectors (all female). It is important to note that the players at the camp had already been identified as 'talented', as they had been selected from a large pool of netballers (over 30,000) in the 13-18 year age range within New Zealand. While the camp was primarily for development purposes, it was also used as an opportunity to select a squad of 17 players for a national age-group team. The players were aware that this camp was a selection opportunity.

6.4 Participants

Ten netball coaches were invited to participate in this study as they were invited by Netball New Zealand to attend an annual development camp. The coaches had a variety of experience coaching at different levels, including the premier competitions within New Zealand (ANZ premiership and the Beko league), and representative regional age group teams (U15, U17, U19). Five coaches were identified as 'head coaches' and the remaining five coaches held the position of 'apprentice coach'. The 49 players at the camp were split into 5 teams (Team A, B, C, D, E) and each team was allocated one head coach (H1, H2, H3, H4, H5), and one apprentice coach (A1, A2, A3, A4, A5) who worked with that team for the entirety of the camp. Two selectors (S1, S2) allocated by Netball New Zealand with vast experience selecting and coaching age group teams, also participated in this study. The selectors did not have a 'hands on' coaching role at the camp, as their role was to select a group of players who would be invited into the squad for the national age group team. Therefore, the selectors' role differed from the coaches'.

6.5 Procedure

The study consisted of three phases (shown in Figure 13 below), which included; familiarisation, observation and questionnaire. Each phase is explained in detail below. The ethical approval confirmation, information sheet, and consent form is included as Appendices J, K, and L.

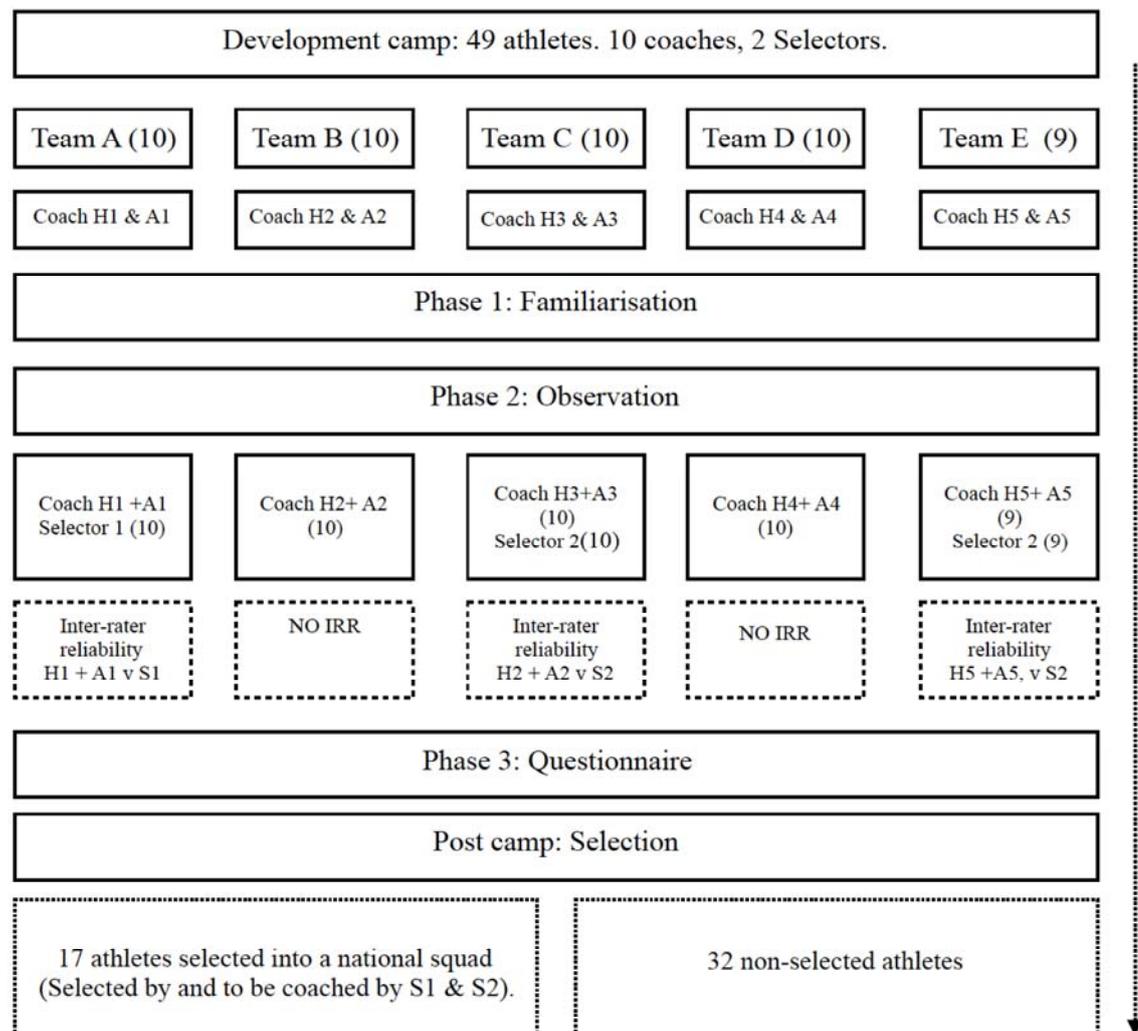


Figure 13: Study overview: Phase 1-3

Phase 1: Familiarisation

Prior to arriving at camp, the coaches were provided with a copy of the TPG and a weblink to a supplementary video explaining the principles and behaviours within the TPG (provided in Appendix M). The coaches were informed that throughout the camp, they would be using the TPG as a lens through which to observe and assess the 9-10 players in their team and provide ratings for each player. The coaches and selectors were asked to use the tactical behaviours in the TPG to inform their ratings for the four tactical principles. Further explanation and opportunity for questions was offered by the primary author in person during the familiarisation phase at the camp.

It is important to note that four of the coaches in this present study have been involved in the two previous studies related in this thesis. In an attempt to mitigate any advantage this may have created, it was ensured that each coaching pair had at least one coach with prior knowledge of the TPG.

Phase 2: Observation

The head and assistant coaches were instructed to observe their team during match play and provide ratings for each team member for each of the four tactical principles in the TPG; space and movement, timing, support and reading play. The scoring system was based on the Dreyfus scale categories; 1: novice, 2: developing, 3: competent, 4: proficient, 5: advanced (Dreyfus, Dreyfus, & Athanasiou, 1986). The selectors were also asked to rate the players on the same tactical principles to create a comparison (inter-rater reliability) between the 'coach' and 'selector' ratings. Selector one (S1) rated team A, and selector two (S2) rated teams C and E. Due to time restraints, all 10 players in teams B and D were not able to be rated by the same selector, and therefore could not be used in the analysis. Each player was given a score between 1-5 for each of the four tactical principles; movement, timing, support and reading play. These scores were averaged to create one 'overall tactical score' (OTS) for each athlete.

Phase 3: Questionnaire

After completing the tactical ratings, on the final night of the camp, the coaches held one-on-one meetings with each team member to discuss their progress throughout the camp. Following these meetings, the coaches answered a short questionnaire related to the effectiveness of the TPG (as provided in Appendix N). Using a five-point Likert scale (strongly agree to strongly disagree), the coaches answered questions related to their level of understanding of the tactical behaviour definitions in the TPG. Additionally, the coach answered whether the TPG enhanced their ability to identify tactical competencies and provide feedback to their team, as well as their confidence in these assessments.

Post camp: Three weeks after the camp, the selectors selected 17 athletes to become part of a national squad. This created a group of 17 'selected' and 32 'non-selected' players.

6.6 Data analysis

Three separate analyses were conducted to determine; 1) the agreement between the coaches and selectors for the tactical ratings given to the players, 2) if there was a difference in scores given to selected and non-selected players, and 3) the coaches

perceptions of the TPG from the questionnaire responses. The analysis for each of these sections is described below.

Agreement: Means and standard deviations were calculated for the overall tactical scores (OTS) provided by the coaches and selectors for teams A, C and E. Inter-rater reliability kappa scores (κ) were calculated from this data. The categories of agreement were drawn from McHugh (2012) which were; 0.01-0.20=no agreement to slight agreement, 0.21-0.4=fair, 0.41-0.6=moderate, 0.61-0.80=substantial, and 0.81-1.00=almost perfect.

Selected vs. non selected players: Differences in the ratings of OTS as well as the individual tactical principle scores between selected and non-selected players were compared using an independent t-test and Cohen's effect size (d). The level of significance was set to $P < 0.005$ for the t-test and effect sizes (d) of 0.10-0.49, 0.50-0.79, and > 0.80 were considered small, medium and large respectively (Cohen, 1988).

Coach feedback questionnaire: Descriptive statistics (percentages) and Pearson's correlations (r) were reported for coaches questionnaire responses.

6.7 Results

Agreement: In Table 13 below, the average OTS scores (means and standard deviations) provided by the coaches and selectors for teams A, C and E are reported. The Kappa scores indicate the level of agreement between the coaches and selectors for the OTS given to the athletes.

Table 13: Means and standard deviations for the OTS provided by the coaches and selectors, and the agreement (κ) between their ratings

	Coaches		Selector		Kappa (κ)
Team A	3.30	(0.48)	2.80	(0.63)	0.09
Team C	3.10	(0.88)	2.40	(0.84)	0.23
Team E	2.67	(0.50)	2.67	(0.50)	0.50
Average	3.02	(0.68)	2.59	(0.63)	

The results indicate a 'fair to moderate' agreement for team C & E (0.23, and 0.50), but 'no to very slight' agreement for team A (0.09). Overall, the selectors' OTS were lower than the coaches' scores.

Selected vs Non-Selected players: From the 49 players who attended the development camp, 17 players were selected into a national squad, and the remaining 32 players were not selected. An independent t-test was conducted to determine if there were any significant differences between the OTS given to the selected and non-selected players.

Coach ratings: The coaches' mean OTS for the 17 selected players was $M=3.29$, $SD=(0.68)$, and for the 32 non-selected players the mean OTS was $M=3.02$, $SD=(0.70)$. The t-test results highlight that this difference of 0.27 was non-significant, $t(47)=-1.33$, $p=0.189$ with a small effect size of $d=0.39$. These results are highlighted in Table 14 below, as well as the mean scores for the selected and non-selected athletes for each of the tactical principles (space and movement, timing, support and reading play).

Table 14: Coach ratings of OTS and individual tactical behaviours for the selected and non-selected players

	Selected (n=17)		Non-selected (n=32)		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
OTS	3.29	0.68	3.02	0.70	-1.33	0.189
Space and movement	3.35	0.86	2.94	0.72	-1.80	0.078
Timing	3.12	0.70	2.88	0.75	-1.10	0.27
Support	3.35	0.79	3.13	0.94	-0.85	0.40
Reading play	3.35	0.79	3.13	0.79	-0.96	0.34

Selector ratings: The selector ratings were also analysed to determine if selected and non-selected players could be distinguished. As shown in Table 15 below, the mean OTS for the 17 selected players was $M=3.29$, $SD=(0.59)$, and the mean OTS rating for the 32 non-selected players was $M=2.34$ $SD=(0.46)$. This difference of 0.95 was significant, $t(47)=-6.23$, $p=0.001$, with a large effect size of $d=1.80$.

Table 15: Selector ratings of OTS and individual tactical behaviours for the selected and non-selected players

	Selected (n=17)		Non-selected (n=32)		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
OTS	3.29	0.59	2.34	0.46	-6.24	0.001
Space and movement	3.12	0.49	2.03	0.54	-6.95	0.001
Timing	3.29	0.59	2.40	0.56	-5.19	0.001
Support	3.41	0.80	2.40	0.61	-4.92	0.001
Reading play	3.35	0.79	2.53	0.62	-4.02	0.001

Further analysis of selected players

To further evaluate the predictive value of the OTS, all 49 players were placed in rank order using the OTS they received from the coach and selector ratings. From this rank order, a list of the top 17 players were identified, to determine if the coach and selector top 17's matched those who were actually selected into the 17 person squad. When creating the top 17 lists, the players were separated into their primary positional groups (shooters, mid-courtiers and circle defence) to ensure that the same positional make-up was reflected in the coach and selector top-17's as were included in the final 17 person squad. Therefore, the top four shooters, top seven mid-courtiers, and top six circle defenders were identified.

When comparing the top 17's created by the coaches and selectors, to those players who were actually selected, the selectors' ratings correctly identified 16 out of the 17 players, while the coaches identified eight of the 17 players as highlighted in Table 16 below.

Table 16: Top 17 ratings from the coaches and selectors

	Coaches' Top 17	Selectors' Top 17
Shooters (4)	3/4	3/4
Mid-courtiers (7)	4/7	7/7
Circle defenders (6)	1/6	6/6
Total	8/17 (47%)	16/17 (94%)

Coach feedback questionnaire

The coaches were surveyed about their perceptions of the effectiveness of the TPG. The results indicate that 90% of the coaches 'strongly agreed' or 'agreed' that the definitions within the TPG were easy to understand, and 80% of the coaches 'strongly agreed' or 'agreed' that the tactical behaviour definitions enhanced their ability to identify a player's strengths or weaknesses. Only 60% of the coaches 'strongly agreed' or 'agreed' that the TPG enhanced their ability to provide feedback to the players.

A Pearson's *r* analysis revealed three significant correlations shown in Table 17 below. A positive correlation of $r=0.75^*$ was found between coaches who believed that the TPG helped them identify tactical behaviours, with an agreement that the TPG helped them provide feedback. In addition, coaches who believed the TPG increased their confidence to identify tactical behaviours had more confidence to provide feedback $r=0.78^*$. When the coaches believed the TPG helped them provide feedback, they had more confidence to give feedback $r=0.81^{**}$.

Table 17: Pearson's correlations for coach response to the questionnaire

	1.Understand	2.TPG helped Identify	3.Confidence identify	4.TPG helped Feedback	5.Confidence feedback
1.Understand					
2.TPG helped Identify	0.56				
3.Confidence identify	-0.4	0			
4.TPG helped Feedback	0.37	0.75*	0.51		
5.Confidence feedback	0.15	0.55	0.78*	0.81**	

*Correlation is significant at the 0.05 level (2-tailed) ** correlation is significant at the 0.01 level (2-tailed)

1=Definitions in the TPG were easy to understand, 2= TPG helped identify tactical behaviours

3= TPG increased confidence to identify tactical behaviour, 4=TPG helped provide feedback to players,

5=TPG increased confidence to provide feedback

6.8 Discussion

This study aimed to explore the predictive value and overall effectiveness of the TPG for assessing the tactical competencies of youth netballers at a development camp. Results indicate that the selectors were better able to distinguish between the selected and

non-selected players, with a 94% success rate (16/17 players), compared to the coaches ratings only identifying 47% of the selected players (8/17 players) as shown in Table 16 above. Most notably, the selectors were able to identify all six selected circle defenders, while the coaches were only able to identify one of the selected circle defenders. A possible explanation for these results may be due to the coaches and selectors having different intentions or purposes behind their ratings. For the selectors at the camp, their ratings were produced with the intent to use this information to aid the selection of a squad of 17 players. Selecting this squad means that the selectors must identify players for each position, while considering how these players work together as a team. Therefore, the selectors may have been adopting a more systemic approach to team selection (Soltanzadeh & Mooney, 2018). In contrast, it is likely that the coaches were rating players on their own merit, and not considering how individuals fit within a team context, thus adopting a more atomistic approach (Soltanzadeh & Mooney, 2018).

From the selectors ratings, all four tactical principles could differentiate between the selected and non-selected players. In previous research, Huijgen et al. (2014) and Kannekens et al. (2011) demonstrated the differences between expert and novice athletes in the 'positioning and deciding' category in the TACSIS tool. There are many commonalities between 'positioning and deciding' with the tactical principles in the TPG, especially the space and movement and reading play principles. For example, the positioning and deciding questions in the TACSIS include, "I know how to get open during a match" (1=almost never, 6=always) and "my positioning during a match is generally..." (1=very poor, 6=excellent) (Elferink-Gemser, Visscher, Richart, & Lemmink, 2004).

An additional finding of value was from the coach questionnaire. The results highlight the coaches believed that the tactical behaviour definitions within the TPG were easy to understand, and the definitions in the TPG helped them identify tactical behaviour. Despite the coaches' lack of sensitivity for distinguishing between selected and non-selected players, the coach perceptions of the TPG imply they see value in it as an effective assessment tool.

Limitations and future research

The opportunity to conduct this study with a large number of athletes participating in a development camp is a strength of this study. However, due to the time constraints and demands placed on the coaches and selectors at the camp, additional data that could have strengthened the research was not able to be collected. As such, rather than rating the four overarching tactical principles, it would have been beneficial if the coaches and selectors provided a rating for each of the 18 tactical behaviours in TPG (nine attacking and nine defensive tactical principles). This may have uncovered potential positional nuances between players. Defensive players (GD, WD, GK) typically perform more defensive behaviours, such as guarding and off-ball guarding than attacking players (GS, WA, GA) (Fox, Spittle, Otago, & Saunders, 2013). Therefore, we may expect defensive players to be better at these defensive behaviours and achieve higher ratings in the defensive tactical behaviours compared to attacking players. In contrast, attacking players (GS, WA, GA), pass and catch more, and may be better at using the attacking tactical behaviours (Fox et al., 2013).

While position specificity for tactical behaviour is yet to be shown in netball, there has been attempts to test it with different decision making tasks (Bruce, Farrow, & Raynor, 2012a). A study conducted by Bruce et al. (2012a), used a perceptual-cognitive test, where participants (split into their positions; shooters, mid-courtiers and defenders) were asked to watch game scenarios and respond with which passing option they would take. These scenarios were selected to mirror the types of decisions that would regularly be performed by the different positional groups to determine if any kind of domain specificity existed. The results found no differences between players of different positions; however, the authors suggested the position specific differences are more likely to become apparent when a motor response is required (as would be seen in real-game scenarios). If positional differences were found, it would also be pertinent to determine different weightings of importance for different tactical behaviours based on the players' positions, and adjust the OTS to these weighting (Den Hartigh, Niessen, Frencken, & Meijer, 2018)

6.9 Conclusion

One of the most challenging, but crucial, skills for a coach is the ability to analyse performance in competitive contexts and use that information to enhance or develop

their team. The use of large testing batteries with a variety of performance variables (technical, tactical, physical and psychological) has been strongly recommended in the literature (Sieghartsleitner et al., 2019). However, the 'coach's-eye' has repeatedly been shown to be one of the most important selection tools (Johansson & Fahlén, 2017). The results from this study highlight that given a purpose (i.e., team selection, as in this study), the TPG can act as a lens for the coach's eye to narrow down the most important aspects of tactical behaviour that should be focused on when assessing players. While coach assessments are inherently subjective, when using a tool like the TPG, it is this subjectivity that allows athletes to be assessed and judged holistically. Thus, the identification of multiple interacting components of performance can be factored into the decisions being made (Sieghartsleitner et al., 2019).

Chapter 7 Discussion

The purpose of this chapter is to present an overview of the key findings from the current Ph.D. thesis. Specifically, this discussion will focus on the new knowledge that has been developed, and the implications this knowledge has on theory.

The overarching aim of the thesis was to answer the question, 'why do turnovers occur in netball'? Due to the lack of netball specific literature available, a logical starting point for answering this question was to gather knowledge from expert coaches. Seeking input from expert coaches was a vital part of the research process as their knowledge has been honed over years of involvement with a specific performance context (Greenwood, Davids, & Renshaw, 2014). Coaches are thus aware of the constraints that impact performance and can provide information about the causative mechanisms that underpin performance to explain the how and why underlying behaviour (Vilar et al., 2012a).

The first experimental study in the thesis (chapter four) acted as the foundation for the Ph.D. The expert coach knowledge gained from the initial interviews resulted in the development of the TPG which included a list of 18 tactical behaviour definitions. A major focal point of the tactical behaviours identified in the TPG was the presence of off-the-ball behaviours that have typically been excluded, or at least downplayed in previous literature (Lemmink & Frencken, 2013). As a reminder, off-the-ball behaviours refer to the behaviours of attacking players who are not in possession of the ball, as well as defensive players not directly marking the ball carrier (Oslin et al., 1998). The relevance of off-the-ball behaviours was highlighted in the expert coaches' ranking of the tactical behaviours. There were three attacking tactical behaviours that were ranked highest for their importance for preventing turnovers including; options to the ball, getting free, and decisive movement, which are all off-the-ball behaviours. In addition, when ranking the defensive tactical behaviours, the coaches identified the off-the-ball behaviours of dictate movement and full team defence as the most important for creating turnovers. The recognition of the off-the-ball behaviours, in addition to many on-the-ball behaviours, provides insight into the range of factors coaches perceive to be important for creating and preventing turnovers in netball; thereby, creating a first step in explaining why turnovers occur.

While the identification of the tactical behaviours within the TPG was highly valuable knowledge to obtain, within the pragmatist philosophy, knowledge is only meaningful when it is coupled with action (Maxcy, 2003). Therefore, once a problem has been acknowledged (i.e., the lack of netball specific research) and is investigated to seek solutions (the development of the TPG), the findings must be turned back into the performance context, where they can be tested, verified and connected to action (Maxcy, 2003). Hence, the tactical behaviours identified by the expert coaches in study one, were only perceived to have value if they could be observed in action. As such, studies two and three were conducted to observe the tactical principles and behaviours in action. The results from these studies have been discussed in depth in chapters five and six, and will not be repeated here. However, the impact that these findings have on theory (and vice versa) are discussed more generally below.

7.1 Key theoretical findings: An ecological perspective for understanding turnovers

A netball team can be described as a complex system whose players interact to produce a large variety of behaviours. An inherent characteristic of complex systems is that interacting players can self-organise to produce coordinated behaviour (Davids et al., 2014). Self-organised teams are not controlled by an external force, such as coach instruction; rather, coordinated behaviour emerges from the interactions between players (Davids et al., 2013). When considering team sport as a complex system, the interactions between players in a system are governed by locally created information (Passos et al., 2013). Players within a team, self-organise or adjust their behaviour based on the behaviours that emerge from their interactions.

The TPG includes a variety of tactical behaviours, that when enacted by individual players, encourage responses, or reactionary behaviours from one's teammates or opposition. The duality of purpose between opposition teams creates an antagonistic system, where the various interactions produce tactical problems for each team to over-come (Grehaigne et al., 1999). The 18 tactical behaviours identified in the TPG can be conceptualised as the result of many collective actions performed to stabilise or destabilise the system (McGarry et al., 2002), and thus create problems or solve problems. For example, decisive movement from an attacking player can perturb the system stability, and therefore allow for a pass to occur. The

capability with which a team can create unstable and stable systems could be considered an indication of tactically proficient behaviour (McGarry et al., 2002). This is because from an ecological dynamics perspective, tactics or tactical behaviour emerge from the complex interactions occurring in the performance environment (Light et al., 2014). Therefore, for players and teams to perform effectively, they must respond and react to their opponents to disrupt their defensive or offensive structure in critical moments in the game.

In solving tactical problems, the concept of 'simple rules' is commonly used in dynamic systems theory to understand the collective behaviour of groups (Duarte, Araujo, Correia, & Davids, 2012). For example, complex biological systems, such as schools of fish or flocks of birds are thought to follow simple rules including; i) maintain an appropriate distance from nearby neighbours, ii) adopt the same direction as those that are close by, iii) avoid becoming isolated (Couzin, Krause, James, Ruxton, & Franks, 2002). In these examples from the natural world, it is the inherent need for survival that dictates an adherence to the rules; while in sporting teams, a desire to win encourages teams to follow organisational rules to act as a coherent force. In invasion sports, researchers have identified some simple rules that are common to different sports; for example, the attacking team seek to create and exploit space by utilising the length and width of the playing space, while the defensive team try to close down and limit space for attackers (Araujo et al., 2016). The tactical principles identified in the TPG could be considered as simple rules that can be applied to solve tactical problems. For example, on defence, the space and movement principle relates to the simple rule of limiting the space the attacking team has to use. While the tactical principles are regarded as the 'simple rules' for solving tactical problems (Costa et al., 2011), the implementation of those rules is observed through the use of tactical behaviours, which provide examples of how to limit space, such as dictating movement, and confusing space.

The tactical principles, denoted as 'simple rules' are different (but connected) to the rules of the sport that are enforced by umpires. The rules of a sport can be understood as informational variables that constrain how individuals behave (Headrick et al., 2015). In order to solve this tactical problem, tactical principles and behaviours are used to overcome the opponent within the rules of the sport. When tactical behaviours are used by players to solve tactical problems, information is created, which

is readily available in the performance environment (Araújo et al., 2019). For example, when a player protects space they are creating information for their teammates about the space that is free to pass the ball into. In this way, the tactical behaviours can act as affordances or invitations to act, because the information created is perceived directly based on what can be done with it (Silva et al., 2013). However, because information is freely available for both teams to use, players must be able to manipulate the available information to create uncertainty for one's opposition, while simultaneously creating certainty for one's own team (Serra-Olivares et al., 2016a). Therefore, as well as affording action for one's own team, players can use the tactical behaviours to manipulate the quality of information exchanged between their opposition, which may force mistakes. For example, the defensive tactical behaviour confuse space is used to make it difficult for an attacking player to know where to pass the ball.

The knowledge gained from the tactical behaviours in the TPG can be used to explain how the interactions between players constrain the emergence of different stable or unstable patterns of behaviour (Passos, Araujo, Travassos, Vilar, & Duarte, 2014). When researchers look for the stable and unstable states in the system, the processes behind turnovers can be better understood. One method used to look at processes (rather than outcomes) is the analysis of perturbations (Barkell et al., 2017; Kim et al., 2019; Reed & Hughes, 2006). A perturbation can be defined as an incident that changes the state of the system from stable to unstable (James et al., 2012). Much of the literature has tended to focus on perturbations that are created by individual players, typically attacking players, who successfully perturb system stability; for example, the behaviours players use that result in a line break (in rugby) or shots at goal (in football) (James et al., 2012). The results from this current thesis offer a unique perspective for understanding perturbations, as netball is an invasion sport with many unique task constraints. For example, the ball carrier cannot move (more than one step), the defensive players are restricted by contact and obstruction rules, and all players are controlled by various positional restrictions. The main findings from this thesis (from a theoretical standpoint), are discussed below and will outline three main findings that contribute new knowledge. These findings include; 1) attacking *and* defensive teams can act with the intention to break the stability of the system, 2)

turnovers are not the result of individual actions and 3) successful perturbations are not due to one perturbation event.

7.1.1 Defensive players actively perturb the system, not just attacking players

A common trend in the ecological dynamics research to date has focused on how attacking players become attuned to the information generated from the environment, and how they use that information to disrupt the defensive team's organisation (i.e., break the stability of the system) (Kim et al., 2019). For example, in basketball, the player in possession of the ball has been shown to detect the distance of the closest defender (interpersonal distance) which can affect the decisions made about their next action (Bourbousson et al., 2014). In this type of 1v1 dyad (one attacker confronting one defender), the attacking player aims to perturb the stability of the dyad, by moving past the defender to attempt to score (McGarry et al., 2002). Meanwhile, the defender aims to preserve or restore the stability of the system by counteracting the attacking player's attempts to perturb the system (Araujo et al., 2006). In this way, the actions of the defensive player implies a passivity to their defensive play, as they are simply reacting to stop the attacker from scoring (James et al., 2012). However, when observing team sport, it is clear that defensive players do not passively react and adapt to an attacking team (all of the time), they are also proactive in their actions to purposefully create turnovers.

The defensive tactical behaviours identified in the TPG provide examples of the proactive behaviours defensive players can use to actively create turnovers. Specifically, the defensive behaviours—attack the line of the ball and contest catch space—describe how defensive players can directly break the stability of the system. The scenario shown in Figure 14 below was one of the video scenarios shown to the expert coaches in chapter five. This scenario provides an example of the defensive team actively perturbing the system to create instability and attempt to actively gain possession of the ball. As shown in this scenario, in the top image (Figure 14, image A) the GK has moved in direction of the black arrow (arrow 1) away from the GS to attack the line of the ball. When the GK moves, this perturbs the stability of the previously stable system. The now unstable system presents a passing affordance for the opposition team, as the GS is free under the goal post. As an immediate reaction, the GD moves into the goal circle (as shown by arrow 2 in Figure 14), attacking the line of the ball to intercept the

pass to GS (as shown in Figure 14, image B). This movement is an example of defensive unity, which explains how defensive teams maintain a unit structure, or re-stabilise, to provide support or cover for their teammates. These tactical behaviours describe the purposeful actions used to gain possession of the ball rather than passively defending.

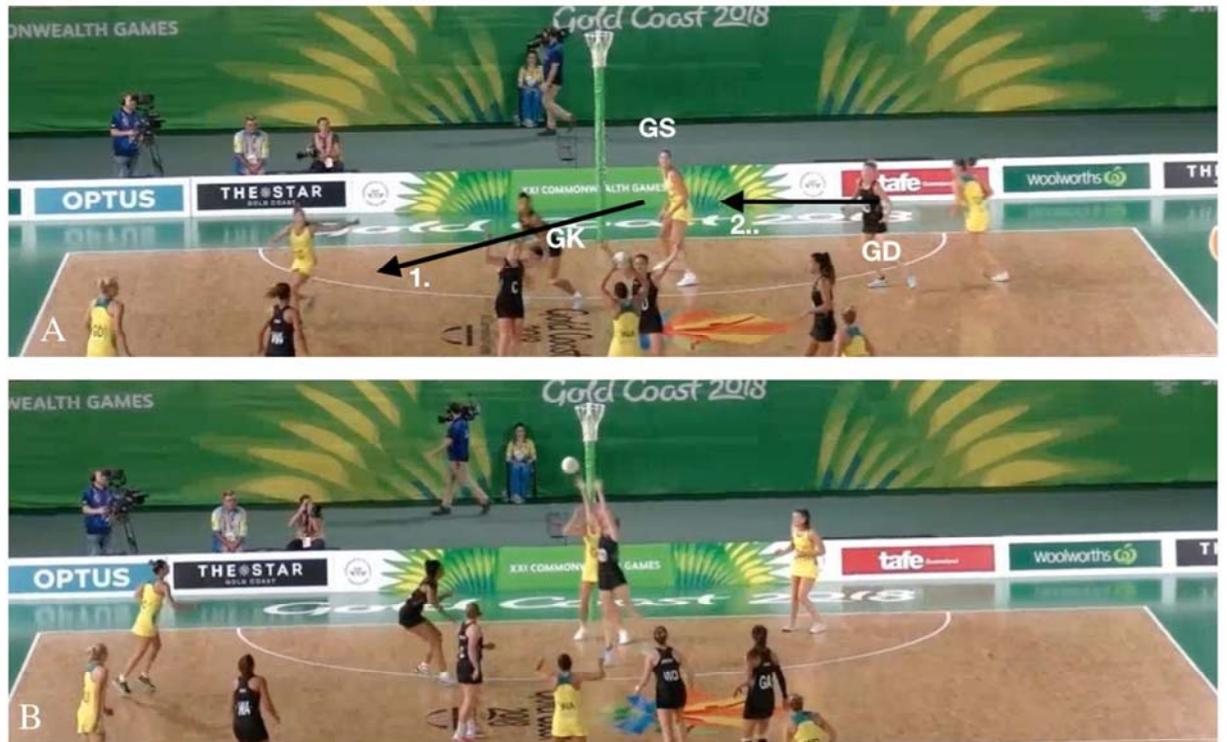


Figure 14: Example of the defensive team system destabilising the system. The top image (A) is a screenshot prior to the turnover occurring. The image underneath (B) occurred one second later, showing the GD gaining the intercept inside the goal circle.

While the team sport literature has typically focused on the behaviours used by attacking players to break the stability of dyadic systems, there is some literature supporting the findings in this thesis, that defensive players also seek to perturb system stability. For example, Gréhaigne et al. (2005) identified an 'attacking' aspect of defensive play, which emphasises the proactive qualities of defensive behaviour. When defensive players act with intent to gain possession of the ball, they purposefully break the stability of the system. As shown in Figure 15 below, this attacking aspect of defence is captured in the attacking tactical behaviour, attack the line of the ball identified in the TPG. In addition, Gréhaigne et al. (2005) recognised the more common, defensive aspect of defense, that is used when defenders are trying to prevent the attacking team from scoring. This defensive aspect of play is captured in many of the defensive tactical behaviours in the TPG including dictate movement as shown in Figure 15. While there is limited literature that has focused on the defensive teams ability to

perturb system stability, the present thesis provides examples of both the attacking and defensive aspects of defensive play that are important for creating turnovers in netball.

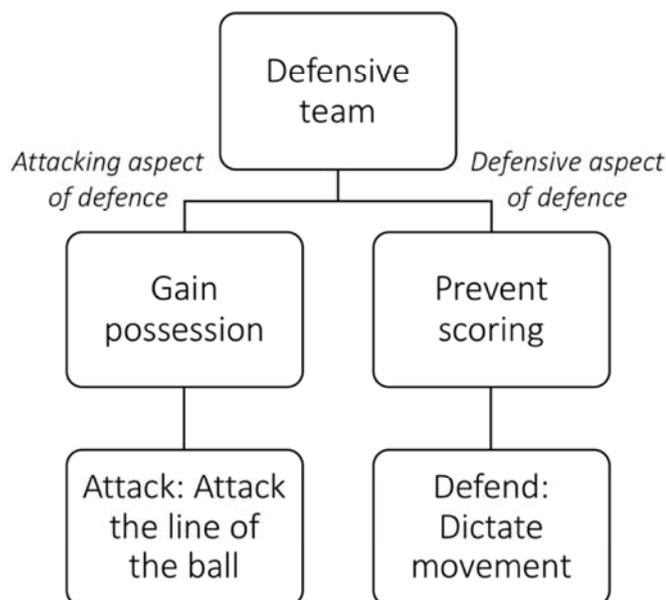


Figure 15: Offensive and defensive aspects of defensive play in netball.

It is possible that past research has neglected to investigate defensive behaviours that perturb system stability, due to the priorities and nature of the task constraints involved in different sports. For example, the study conducted by Barkell et al. (2017) involved rugby 7's, and Kim et al. (2019) focused on football. In both rugby and football there is a relatively low rate of scoring (i.e. the number of tries or goals scored in a game), compared to sports like netball and basketball. In rugby 7's, approximately 48% of attacking perturbations lead to tries being scored, which is only between 2-4 tries per game (Barkell et al., 2017). In football, one study has shown that 12.64% of turnovers resulted in scoring opportunities, with only 1.10% resulting in a goal being scored; that is, approximately 1.2 goals per game (Hughes & Lovell, 2019). In contrast, in netball there is often over 100 goals (50 per team) scored in a 60 minute international test match (Champion Data, 2019). Due to the comparatively low rate of scoring in football and rugby, it is logical that researchers would prioritise discovering how to create more scoring opportunities over understanding how to defend against scoring. However, in netball, as goal scoring is part of the normal flow of the game, it is the ability to create turnovers on defense, and score from them, that is often a determining factor between winning and losing (O'Donoghue et al., 2008). Therefore,

the focus on understanding the perturbation factors that lead to turnovers from both the attacking and defensive team is warranted in netball.

7.1.2 Understanding the attacking tactical behaviours used to perturb system stability: Ball carrier movement is not always necessary

While past research has detailed the attacking perturbations that players can use to destabilise the defensive team and create scoring opportunities, the results from this present thesis offer a unique perspective for understanding attacking tactical behaviours. This is because in contrast to most invasion sports, such as rugby, football, hockey or basketball, in netball, the player in possession of the ball cannot move around the court. For example, in basketball, the ball carrier can dribble the ball and move freely to perturb the defensive system and create scoring opportunities. However, in netball, as the ball carrier cannot traverse through their play space, they are unable to perturb the system directly through their own movement. Interestingly, the TPG includes tactical behaviours that could be considered as attacking perturbation factors that can be used without the ball carrier moving through the play space. In particular, the tactical behaviour, pace of the ball, can be used by the ball carrier, where the type of pass or the timing of pass release can be manipulated to destabilise the defensive team's organisation. In support of this finding, in an unpublished Master's thesis, the author identified 'ball flight time' and 'ball contact time' as being potential perturbation factors in netball (Kennedy, 2010). Ball flight time refers to the amount of time the ball is in the air (which relates to the type of pass; i.e., a fast, flat pass vs. a slower lob style pass), and ball contact time refers to the speed of the release of the pass (which refers to the time the attacking player held the ball for before passing it) (Kennedy, 2010).

Another example of a perturbation factor used by the ball carrier is the use of the tactical behaviour draw or fake. The 'fake' component, also referred to as a feint in other sports (McGarry et al., 2002), is used when the player in possession of the ball pretends to pass the ball in one direction, to trick the defensive player to move that way, but then they pass in a different direction. The fake maneuver enables space to be opened, perturbing the defensive teams organisation. Therefore, while the player in possession of the ball cannot move around the court to perturb the system, they still have the ability to perturb the system, through small deceptive movements or changes in timing. An important point to consider, is that players can perceive affordances for

and of others (Fajen et al., 2008). Therefore, in order for a tactical behaviour to be successful, another player actually has to identify the affordance. For example, if the fake is used, but neither the player's teammate, nor the opposition defender realises that affordance, then the behaviour would not be effective. In this way, the interpersonal nature of tactical behaviour is very important to consider, and is explored further below.

7.1.3 Turnovers are not the result of individual actions

As discussed in chapter one of this thesis, notational methods are problematic as they fail to capture contextual information, such as the collective behaviours of players that occur away from the ball that may have contributed to causing or creating the turnover (Mackenzie & Cushion, 2013). In this way, notational methods tend to capture the efforts of the one player who gained possession of the ball, as well as the error of one player who lost possession of the ball. However, as shown in the results in chapter five, there was an average of 4.86 defensive players identified as being involved with creating the turnovers, and an average of 3.96 attacking players involved with causing the turnovers. If we round these numbers up, the coaches identified an average of eight players (five defenders, and four attackers) being involved in a turnover, which is much different to the two players (one attacker and one defender) typically identified in notational type analyses.

The number of players identified as being involved with creating turnovers is indicative of the general principle of 'numerical superiority' (Costa et al., 2009). Numerical superiority occurs when one team has more players involved in active play than the opposition team. Of the ten scenarios analysed in chapter five, eight scenarios were identified by the expert coaches as having more defensive players involved than attacking players. For the remaining two scenarios, the coaches identified an equal number of attackers and defenders (numerical equality). Therefore, in most scenarios, the defensive team was able to attain numerical superiority within a certain area of the court, which may be one factor that contributed to creating the turnovers.

Numerical superiority is an example of a task constraint that is often manipulated in research (Lemmink & Frencken, 2013). Much of the previous research looking at numerical advantage in team sport, has focused on understanding how

players react to numerical superiority when it is imposed on them as part of an experimental design (i.e., when it is controlled externally by a researcher). Small-sided games research has shown how the number of players involved can shape the emergence of different individual and collective tactical behaviours (Ometto et al., 2018). In a football study, researchers analysed simulated 4v4 and 3v4 game scenarios, to look at differences in tactical performance. It was shown that when the defensive team was manipulated by the researchers to create numerical inferiority (3v4), the defenders behaviours highlighted increased coupling behaviours (Travassos et al., 2014). This coupling behaviour was observed as the defensive players positioned themselves closer together, taking up less space and positioning themselves to prioritise protection of the most important location—the goal (Travassos et al., 2014).

The tactical behaviours in the TPG can be used to describe how netball players adjust to naturally occurring numerical disadvantages. In Figure 16 below the GK (in yellow) has been penalised outside the goal circle, meaning that she has to stand beside the WA until the pass has been released. In this way, the GK can take no part in the game (not even to verbally instruct her teammates) until the pass has left the WA's hands. This scenario provides an example of the defensive team being numerically inferior in that moment. To clarify, there are six attacking players and five defensive players who can legally participate in the game at this moment. As the GK is outside the goal circle, a 2v1 situation has been created inside the goal circle (GD (in yellow) vs GA & GS (in black)), meaning that it should be easy for the WA to pass to either the GA or GS, who are in a position to score a goal. In an attempt to neutralise the numerical disadvantage of the defensive team, the WD (in yellow) positions herself in the direct line of vision of the WA (in black), and uses the tactical behaviour, to delay and disrupt ball offload, to make it difficult for the WA to see a clear passing option. In this way the defensive actions of the WD have been coupled with her defensive teammates (in particular GD) to attempt to restrict the easy pass into the goal circle.



Figure 16: Example of numerical superiority in netball and actions taken to limit the effects of numerical superiority

As identified above, Travassos et al. (2014) provided examples of how player behaviour changes as a result of numerical inferiority. However, it is important to note that in the Travassos et al. (2014) study, the researchers manipulated the number of players involved to produce the behavioural effects identified (i.e., the research captures how players respond to numerical superiority or inferiority). In real game contexts, that have not been manipulated by a researcher, each team begins with an equal number of players and therefore, in order to gain a numerical advantage, players must act to create the advantage. In this way, it is important to understand how different tactical behaviours can be used to create numerical advantage or to limit the momentary effects of numerical disadvantage.

7.1.4 The accumulation of perturbation attempts creates turnovers

When considering why turnovers occur in team sport, James et al. (2012) suggested that rather than focusing on successful perturbations (i.e., goals scored or turnovers gained), perturbation attempts that are unsuccessful may help explain the processes behind the turnover. For example, a defensive team may constantly disrupt the momentum of the attacking team through small disrupting behaviours such as, contesting catch space and delaying ball offload for every pass. Defensive players may even purposively contact or obstruct the opposition team to build pressure and frustration in the attacking team. During such sequences of play, there might be several

incidents where the defensive team almost create a turnover, building the pressure each time. Eventually, this accumulation of pressure builds to a point where a turnover becomes more likely. Therefore, it may not be the tactical behaviours observed immediately prior to the turnover that can explain why it occurred; rather, it is the disruptive, pressure inducing actions performed over time that can explain the turnover. This idea is expressed in the expert coach quote below, from Appendix F.

You pressurise them catching the ball, that upsets the timing for everything else down court, so it's kind of like a ripple effect. So what I always try and coach is that, that one-on-one defence... you're really causing them to have to work hard to get free, to change direction a lot of times, to do a lot more than what they are used to, and there's a wear down effect over time, but that... what that also does is it puts in indecision in the attacking... the person with the ball, where to pass it, whether they do pass it or not, and it changes the space of passing it, so by doing that you're actually creating an intercept for one of your team mates. (Expert coach one)

The quote from expert coach one suggests that the defensive actions of players can cause a ripple effect or accumulated pressure over time. The idea of the ripple effect is analogous to the idiom, 'the straw that broke the camel's back', where the impact of more weight added to the camel's load, can build up to become too heavy and thus 'break the camel's back'. In the same way, the incremental impact of defensive pressure, can add up to reach a breaking point for the attacking team, where the next defensive action will create a turnover. So while a coach may be able to identify various defensive tactical behaviours that occurred immediately prior to the turnover, it may actually be the unobserved accumulative effect of those actions over time that created the turnover. Therefore, rather than focusing on stand-alone perturbation factors, it is important to acknowledge that unsuccessful perturbation attempts (such as a defensive player almost intercepting a pass) can create disruptions for the attacking team.

To summarise, the discussion chapter thus far has highlighted how the findings from the thesis have had an impact on theory. In particular, due to the unique task constraints of netball, the results from the thesis have highlighted that both attacking and defensive players can act with the intention to break the stability of the system. Furthermore, turnovers are not the result of individual actions and successful perturbations are not due to one event. The final section of this discussion will reflect

upon the research process, with specific focus on the impact that the methods (Delphi method) and the theoretical perspective (pragmatism) had on the thesis.

7.2 Reflection of the research process in this thesis

To date, few studies have used the Delphi method to capture expert coach knowledge to create an understanding of tactical behaviour in a team sport. One strength of the current research was the intention to create a clear and transparent process for capturing expert knowledge, and then to refine that knowledge to create consensual guidelines for defining and identifying tactical behaviour in netball. Therefore, this study makes an important contribution in signposting how to construct research to capture the expert voice. Within the literature, some researchers have criticised the Delphi method as they believe it forces the convergence of opinion into one agreed upon version of reality (Keeny et al., 2011). At first glance, this notion of converging opinion seems to be in direct opposition to the ideals of pragmatism, which emphasise the existence of multiple realities. In traditional Delphi research, the concept of consensus was thought of in a statistical sense, where results were quantified to seek answers in a recognisably positivist approach (Amos & Pearse, 2008). However, when the Delphi method is used to answer research questions that are seeking the identification, description and exploration of ideas, they are more qualitative in nature and capture many ideas (Amos & Pearse, 2008). Therefore, in the current thesis, the qualitative modifications made to the Delphi method allowed for multiple perspectives to be captured, which incorporated many contextually dependent truths. For example, following the interviews from round one of the Delphi study (chapter four), the tactical behaviour, continuous movement, was identified and defined as “the actions of players to create the illusion that spaces on court are covered”. When the coaches rated their agreement to the definitions, continuous movement received an I-CVI score of 0.80, meaning that it would have been considered content valid. However, upon investigation of the coaches’ suggested amendments, it was clear that the definition needed to be changed. A similar process was adopted in research conducted by Krause et al. (2018) to validate a tool to assess tennis practice. Rather than focussing on consensus reaching over 80%, the majority of changes to the tool were based on expert comments which Krause et al. (2018) acknowledged as being atypical of other Delphi research. In this way, consensus can have pragmatic ideals because seeking consensus is to look for the

thing upon which most people agree on, most of the time. Therefore, in this thesis obtaining consensus was used to solve the wider problem of creating a tool (the TPG) that is accepted and well received; thus, more likely to be adopted into practice.

Despite the perceived limitations of the Delphi method, the TPG was never intended to represent one version of reality or one method to create or prevent turnovers. Rather, as the TPG includes 18 tactical behaviours, coaches can choose to utilise only the behaviours that serve them best. The inclusion of 18 different behaviours has practical applications because in non-linear systems (i.e., team sport) any action or behaviour performed may have multiple behavioural effects; that is, they are considered to be multi-stable (Chow, Davids, Hristovski, Araujo, & Passos, 2011). This idea is related to a key component in dynamical systems theory that can be linked to tactical creativity—*multi-stability*. Multi-stability suggests that there can be more than one tactical solution for a given problem (Memmert, 2015). For example, the tactical problem of ‘how to regain possession’ on defence, can be achieved in multiple ways using a variety of the tactical behaviours in the TPG.

7.3 Summary

The current thesis has provided a compelling case for how ecological dynamics can be used to better understand and exploit tactical behaviour in team sport. In particular, this research has expanded on the very limited netball specific literature to identify the tactical behaviours that are related to creating and causing turnovers in netball. As highlighted in this chapter, the tactical behaviours defined in chapter four form the foundation for understanding turnovers in netball. Unlike past research, which has focused on reductionist methods of analysis, the tactical behaviours in the TPG recognise the various behaviours that occur both on and off the ball, used by defensive and attacking players. The discussions in this chapter emphasised that both defensive and attacking teams can actively perturb the system, and the tactical behaviours used to do this can be identified in the TPG. In addition, turnovers are the result of many behaviours that accumulate over time rather than from one ‘perturbation incident’.

For Deweyan pragmatists, the new knowledge gained from this thesis can only be conceived as knowledge when it guides action to solve problems. From this perspective, the value of knowledge is not based on whether it is true or not, but on the extent to

which achieves its external consequences (Bishop, 2015). The TPG is seen as a living resource with moving parts, that will continue to evolve as netball does. In order to ensure the TPG continues to be developed, recommendations for future research are presented in chapter eight, the 'future research' section. In the following chapter, the practical consequences of this research will be outlined, as well as presenting the limitations of the current thesis and future research directions.

Chapter 8 Conclusion

This final chapter concludes the thesis by building upon the key theoretical findings identified in the previous discussion chapter. The current chapter will also reflect upon the practical contributions this research has made to Netball New Zealand, as well as some of the key limitations of the research and future research directions.

The tactical behaviours identified in this thesis have been used to answer the question 'why do turnovers occur in netball'. Put simply, this thesis has shown that turnovers result from the actions of many interacting players, rather than the actions of one player alone. While the TPG can be seen as a series of tactical actions defined and listed separately, it is their combined use that creates turnovers. For example, the results from study two, highlight that coaches identify multiple players, using a variety of tactical behaviours to create and cause turnovers. While this research has not identified a set formula, or single answer to the question of why turnovers occur, the TPG offers a clear starting point to understand the complexity of turnovers in netball.

This understanding of how turnovers occur, was enhanced by the use of the ecological dynamics perspective. Ecological dynamics is particularly well suited to understanding tactics, as tactical behaviour is essentially behaviour, in action, where individuals must respond and react directly to what they see (Light et al., 2014). As direct perception is a core tenet of ecological dynamics, it describes how unpredictable behaviours, which are inherent in team sport, can be responded to by teams or units of players (Araújo et al., 2019). This notion of unpredictability is not well explained in traditional cognitivist models that suggest that teams coordinate based on shared knowledge (Silva et al., 2013). Shared knowledge, such as a specific game plan or team structure can inform how a team will play, however, they cannot accurately predict the behaviours of the opposition team. Therefore, players within a team must be able to respond to the unpredictable and changeable behaviour of others in the moment. As ecological dynamics proposes that we act based on affordances in the environment, all potentialities for action are in the world to be perceived, rather than mental representations (Button et al., 2020).

It should be made clear that it is not the position of this thesis that shared knowledge doesn't exist, in fact, the concept of shared knowledge is defined as 'knowledge about' the environment from an ecological dynamics perspective (Araújo et al., 2019). Knowledge about the environment, such as coach instruction or set plays, is solidified through physically practicing that knowledge with the team until it becomes shared and embodied knowledge (Button et al., 2020). Therefore, rather than drawing upon mental representations in every new situation, players have learned to become perceptually attuned to the affordances that are created for them. For example, the tactical behaviour, delay and disrupt ball offload, creates intercept affordances for one's team mates. Adopting these behaviours allows players to act synergistically to react to different game scenarios (Araujo et al., 2015).

A central point of this research, and one of the key practical contributions made to Netball New Zealand, was the development of the TPG. The rationale for creating the TPG was that the tactical competencies in the original Netball New Zealand player profile lacked clarity. As a result of the research conducted in this thesis, the four tactical principles in the TPG—space and movement, timing, support and reading play—have now replaced the three categories of tactical competency in the original player profile—decision making, reading play and court presence. In addition, the inclusion of 18 tactical behaviour definitions, that expand upon the tactical principles, has ensured that there are now clear and concise definitions of tactical behaviour to be used by Netball New Zealand.

In replacing the tactical component of the original player profile, the TPG is now being used by coaches and selectors to aid the assessment of players at the entry point of the development pathway. As described in the introductory chapter, the original player profile was typically used when players were identified and inducted into the high-performance system. At present, the assessment process involves coaches or selectors observing players (during games) and rating them (novice, developing, competent, proficient or advanced) for each of the four tactical principles. In addition to this rating system, the coaches and selectors are able to select a player's strengths and 'work-on's' (limitations) and provide specific feedback as shown in Figure 17 below.

TACTICAL PRINCIPLE: SUPPORT

Rate the athletes ability to use the support tactical principle.

Support (?)

Novice Developing Competent Proficient Advanced

From the options below, select the athletes strengths and work-on's that you wish to comment on.

Support Strength(s) Options to the ball
 Defensive unity
 Full team defence

Support work-on(s) Options to the ball
 Defensive unity
 Full team defence

Support: Strength(s) comment
 Likes to work in a unit and is a good talker in circle.
 Displays good leadership on court.

Support :Work-on(s) comment

Figure 17: Example of how coaches assess the support principle as part of Netball New Zealand's adapted player profile.

For pragmatic researchers, the value in research findings are based on the extent to which they can help make predictions and solve practical problems (Giacobbi et al., 2005). For coaches, the value of research may be derived from improved communication with players, or by guiding the design of training activities to ensure players are improving and developing. Therefore, for this research to be considered successful, it must be deemed effective by the coaches who may be using it. From this perspective, an important way to assess the value of the research is to ask the coaches and selectors who have had experience using it. The feedback provided by the coaches who attended the development camp (in chapter six), suggested that the definitions within the TPG were easy to understand and that the TPG enhanced their ability to identify a player's strengths or weaknesses. In addition to the development camp, the TPG has continued to be used by various coaches and selectors independently of the research conducted in this thesis. A variety of coaches and selectors have provided testimonials regarding the practicality of the research⁷.

8.1 Coach testimonials

Alana's research and subsequent tactical principles guideline has been instrumental from an assessment point of view. Her guidelines now form the basis from which we provide feedback to players. We have also used the guidelines when formulating our coaching sessions and have found it to be incredibly useful and worthwhile. (Anna Galvan, Mainland Tactix, apprentice coach, 2019)

Excellent tool - has added great value to our game allowing for a shared language to aid clarity in conversations. It has simplified the

⁷ These coaches gave permission to use their names in the thesis.

interpretation and allowed for discussions to be had in conversations with players as feedback indicators, in assessing the players understanding of tactical requirements pre, post and in game. (Yvette McCausland-Durie, Central Pulse, head coach, 2017-2010)

The tactical guidelines provided clarity in the use of language in discussions and identification of key aspects we needed to be demonstrated by athletes. The guidelines were used as a point of reference when observing BEKO⁸ National League games and also at National Development Camp. The common language used on CYA⁹ in player feedback and this guide gave us real continuity. As a coach I found it useful when doing my post-match reflections and providing feedback to units and individual athletes and working with my Head Coach. It ensured that myself and Head Coach used the same language when communicating to athletes and each other. It reduced confusion. (Paula Smith, New Zealand Secondary Schools coach 2019)

The hard work has been done in creating this - the next step is bringing that to life and embedding this in the netball system. We have been trying to use the language and interestingly, on my travels this year, I have started to hear that language in different environments. Coaches could incorporate into their season planning workshop and also I feel we need to educate on skill acquisition for the various areas. This would be a great framework for coach education as well. Sharing some of this with coaches as they organise and select their teams, and then also sharing videos, what does contesting the catch space look like when done well or attacking the line of the ball? What does it look like when a novice is attempting that skill? Coaches and selectors appreciate a visual benchmark. (Charissa Barham, New Zealand Secondary Schools coach 2017-2019)

8.2 Thesis limitations

Team sports, such as netball, are inherently complex, making the identification of tactical behaviour very challenging. With a myriad of behaviours occurring both on and off-the-ball, it is difficult to accurately identify all of the tactical behaviours that may have contributed to a turnover. The difficulty of identifying causal behaviour is particularly evident when we consider that not all tactical behaviours will necessarily, nor immediately, create a turnover. In other words, if one defensive player uses the tactical behaviour contest catch space, and another three players confuse space, this does not mean a turnover will inevitably occur as a direct result of those behaviours

⁸ The Beko national league is the development league in Netball New Zealand.

⁹ CYA is the player data management system that has recently been put in place by Netball New Zealand. Otherwise known as Smartabase outside of Netball New Zealand.

being used in that moment. Rather, turnovers are more likely to result from an accumulation of pressure over time. For example, if the defensive team uses full team defence and contests catch space for every pass over a five-minute period of play, this may build pressure enough to eventually result in a turnover. Based on this knowledge, and upon reflection of chapter five, the scenarios chosen, at an average of 10.7 seconds, may have been too short to capture the accumulated effect of different tactical behaviours over time. However, a balance had to be struck in terms of including scenarios that provided enough context, but not making the scenarios too long to cause confusion or demotivation for the coaches. Future research may look more at the cumulative patterns of pressure over time using automated processes.

A further limitation in this thesis was that while all 18 tactical behaviours were considered identifiable, the notion of 'identifiability', used in chapter five, must be assessed cautiously. From a critical realist perspective, captured in a pragmatic approach, reality exists independently of a human's capacity to comprehend it (Levers, 2013). In this way, the "observation of an entity is not required to determine whether it exists" (Levers, 2013, p. 2). In other words, if nine coaches identified a tactical behaviour and one coach did not, this is not proof that that behaviour did not exist. The results from chapter five, highlighted three instances where only nine of the ten coaches identified the tactical behaviours; full team defence, pace of ball and reading patterns. However, as suggested above, just because one coach did not identify these behaviours it is not proof that they do not exist. Rather, what should be focused on within the pragmatic approach is how the identification of a tactical behaviour can have practical implications for the coach who identified it. If identifying the behaviour helps the coach decipher why a turnover occurred, then its pragmatic consequences have been realised. Likewise, if the coach can explain why a turnover occurred without certain tactical behaviours, then that is their non-contestable version of reality. It is also important to consider 'identifiability' outside of pure observation, because in some cases the object (or tactical behaviour) may not be directly observable (Levers, 2013). For example, the tactical behaviour space awareness may not be directly observed; rather, the result of good space awareness, such as an accurate pass or movement into a free space, is what is observed.

Another potential limitation of this research was that it was created alongside New Zealand netball coaches, for application with New Zealand netball players. As a result, there is the potential that the tactical principles and behaviours included in the TPG would not be considered important (and thereby generalisable) across all international teams. For example, New Zealand is known for its zone style defence, which is identified in the defensive tactical behaviour defensive unity. However, for Australian teams who are better known for a very tight, one-on-one defensive style, other behaviours such as contest catch space might be considered more important. In addition, the coaches creating the TPG were, for the most part, coaching elite open age group players; therefore, the TPG may capture a range of skills that are not applicable to all age levels. Santos, Memmert, Sampaio, and Leite (2016) suggested that there are different stages of tactical creativity; thus, some elements of tactical behaviour are too advanced for younger players. For example, in early developmental stages, young players discover how to use fundamental game principles to support their teammates, such as using gaps and playing together. As they get older (16+ years), athletes adopt more specific collective tactical behaviours, such as anticipation and awareness of affordances (Santos et al., 2016). In this current thesis, the footage used in chapter five only included players over the age of 16; and in chapter six, there were only three of the 49 players who were younger than 16. Therefore, there is the potential that the results from these studies may not be applicable to younger netballers who are still developing their tactical skill. At this stage, the TPG would not be recommended in its current state for use with younger players or for players outside of New Zealand.

8.3 Future research suggestions

The findings of this research form a strong foundation through which future research can be built upon. As this thesis has provided new knowledge about the tactical behaviours that can create or cause turnovers, the next step is to determine how these tactical behaviours can be developed in athletes and teams to improve performance. A key finding from this thesis is that tactical behaviour can only be understood at the performer-environment level of analysis. Therefore, for future research, it is vital that the relationship between the performer and their environment is preserved. The maintenance of the performer-environment relationship can be achieved when full games are used for analysis, as full games are able to capture the complex interactions

that occur in space, between all 14 players on court. Potential research questions to explore further include;

- Are any of the tactical behaviours in the TPG quantifiable?
- How can the tactical behaviours in the TPG be used to develop tactical competency in teams?
- Can a training intervention based on enhancing specific tactical behaviours increase turnovers on defence, and reduce turnovers on attack?

It is important to note that the focus of this current thesis was on understanding the factors that cause and create turnovers to essentially win games. However, winning is not always the priority for coaches. In a recent study, Mclean et al. (2019) identified five 'functional purposes' for netball, which refer to the 'reasons for playing'. In addition to winning the game, these functional purposes included; implementing the game plan, progressive team improvement, demonstrating team values and providing entertainment. These functional purposes emphasise that a coach's focus could be on player development rather than solely on performance. When focusing on development, a coach may have a specific strategy or game plan that they want to implement. The strategy could include the implementation of two of three tactical behaviours. Coaches can then come up with their own methods to either qualitatively or quantitatively measure the improvement of those behaviours as they align with the execution of a game plan or strategy. The purposeful selection of specific tactical behaviours is a method that has been adopted in other assessment tools, such as the game performance assessment instrument (GPAI). When using the GPAI, teachers or researchers choose to observe any or all of the seven components included in the GPAI, depending on the goals or objectives of a training session (Oslin et al., 1998). Therefore, future research should look at how specific tactical behaviours can be developed and assessed over time.

In addition to the research suggestions above, there are planned proposals for the future development of the TPG and its implementation within Netball New Zealand. To begin with, the tactical principles guideline video (Appendix M), will be expanded upon to create a whole library of videos that provide a variety of examples of the different tactical behaviours in the TPG. These videos will include the behaviours being performed by players at different developmental stages, in many different contexts.

There is also the potential for the development of a mobile application (App), which will house the library of video examples that are created. The App would include all of the tactical behaviour definitions and potentially enable coaches and selectors to conduct assessments. A basic prototype for this App has been developed and the link can be found in Appendix O.

8.4 Summary

This current thesis has contributed new and expanded upon original knowledge to the invasion sports literature (see the list of publications accepted and under review on page xi). With the acknowledgement of the importance of off-the-ball behaviors in creating and causing turnovers in netball, future research can be focused on how to develop these aspects of tactical behaviour. It is equally important to emphasise the practical impacts this research has had on the netball community as highlighted by the coach and selector testimonials on page 108-109 above. Pragmatically speaking though, it is important to acknowledge the fallibility of knowledge. We can never be certain that what is supported in research now, will continue to stand in the future. Therefore, the knowledge gained from this thesis is only the beginning for where netball specific research will develop in the future.

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Appendix A: Pilot Study Ethics Approval¹⁰

14 September 2017

Sarah Kate Millar
Faculty of Health and Environmental Sciences
Dear Sarah Kate

Re: Ethics Application:16/436 Investigating coach understanding of tactical skill in netball
Thank you for your request for approval of an amendment to your ethics application.

The amendment to the recruitment protocol is approved.

I remind you of the Standard Conditions of Approval.

1. A progress report is due annually on the anniversary of the approval date, using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>.
2. A final report is due at the expiration of the approval period, or, upon completion of project, using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>.
3. Any amendments to the project must be approved by AUTEK prior to being implemented. Amendments can be requested using the EA2 form: <http://www.aut.ac.nz/researchethics>.
4. Any serious or unexpected adverse events must be reported to AUTEK Secretariat as a matter of priority.
5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEK Secretariat as a matter of priority.

Please quote the application number and title on all future correspondence related to this project.

AUTEK grants ethical approval only. If you require management approval for access for your research from another institution or organisation then you are responsible for obtaining it. If the research is undertaken outside New Zealand, you need to meet all locality legal and ethical obligations and requirements.

For any enquiries please contact ethics@aut.ac.nz

Yours sincerely,



Kate O'Connor
Executive Manager

¹⁰ A pilot study was conducted (not reported in this thesis), where coaches were interviewed in a focus group setting. This original ethics application was subsequently amended for the interviews in study one. As shown in Appendix B below.

Appendix B: Study One Ethics Approval (Amendment)

18 November 2016

Sarah Kate Millar
Faculty of Health and Environmental Sciences

Dear Sarah Kate

Ethics Application:16/436 Investigating coach understanding of tactical skill in netball

Thank you for submitting your application for ethical review to the Auckland University of Technology Ethics Committee (AUTEC). I am pleased to confirm that your ethics application has been approved for three years until 17 November 2019.

As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 17 November 2019;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>. This report is to be submitted either when the approval expires on 17 November 2019 or on completion of the project;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,



Kate O'Connor
Executive Secretary
Auckland University of
Technology Ethics Committee

Appendix C: Participant Information Sheet

Date Information Sheet Produced: 11 September 2017

Project Title: Investigating coach understanding of tactical skill in netball

An Invitation

You have been invited to participate in a research project being conducted through the AUT Sports Performance Research Institute New Zealand (SPRINZ). This project is being undertaken by Alana Coombe, a PhD candidate from the Faculty of Health and Environmental Sciences. Alana is supported by Netball New Zealand to carry out this project, as it is seen to be an important first step in developing a protocol for the development of tactical skill in Netballers.

Participation in this project will involve engaging in an interview with the researcher for between 45-60minutes. This interview will be run by Alana Coombe (primary researcher) at a time and location to be specified with each individual. You will also be asked to complete two online surveys in the months following the initial interview. These surveys will take approximately 30 minutes to complete. More information about the dates of these surveys will be communicated to you closer to the time.

Please note, that under no circumstances will any identifying information be included in this report, and that participation is completely voluntary. There will be no adverse consequences if you choose not to participate. You may withdraw from this study at any time.

What is the purpose of this research?

Alana is undertaking this research for her PhD thesis at AUT-University. This research aims to add relevant literature specifically to Netball to provide evidence to support the development of assessment tools for the tactical aspects of turnovers. This research is anticipated to have a positive impact on the development of future netballers, and help coaches enhance tactical skill and awareness. It is hoped that this research can be published in relevant academic journals.

How was I identified and why am I being invited to participate in this research?

You have been invited to participate in this research given your involvement in Netball coaching or playing at the required level. Your insight, experience and knowledge is seen as a valuable resource for this research. This research is directed for those who are/have coached or played at High Performance levels and all coaches who have been identified at this level, are being invited to participate.

How do I agree to participate in this research?

Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time. If you are interested in taking part in this research, you will be required to reply to Alana Coombe to register your interest. Formal consent procedures will take place once a time and date has been set for the initial interview.

What will happen in this research?

Should you wish to take part in this research you will be asked to:

- Sign a participation consent form
- Engage in an interview for 45-60minutes
- This session will be audio-recorded and notes will be taken with your permission.
- During this time, you will be asked to engage in discussion to respond with your opinions to the research questions.
- In the follow-up surveys, you will be asked to rank the importance of different themes, and rate your agreement for a series of definitions.
- This will take approximately 30minutes.

Data collected from the interview and surveys will be used only for the purpose of this research, and will be kept confidential by Alana Coombe. The interviews will be transcribed verbatim and you will be given the opportunity to read the transcripts after they have been transcribed.

What are the discomforts and risks?

There is no intended risk or discomfort.

How will these discomforts and risks be alleviated?

You will not be required to answer any questions you feel uncomfortable answering.

What are the benefits?

Through participating in this research, it is hoped that it will be a self-reflection process as well as a learning opportunity. Through sharing ideas and knowledge, it is hoped that awareness is drawn to the importance of developing tactical skill. You will also have a valuable role in shaping the rest of the Alana's' PhD, which is hoped to improve tactical skill in Netballers across the development pathway. Your participation will therefore assist in the researcher obtaining her PhD.

How will my privacy be protected?

Your personal details will be kept confidential throughout the duration of this study. The primary researcher will be held to a confidentiality agreement and will not share who participated in the research.

What are the costs of participating in this research?

There are no monetary costs involved in the participation of this research. It is expected that your participation will require a total of approximately 2 hours of your time.

What opportunity do I have to consider this invitation?

You have three weeks to consider this invitation. If you are interested in taking part, you must email Alana Coombe within this time to register your interest. Once you have confirmed your interest, a time and location will be organised for Alana to come and complete the first interview.

Will I receive feedback on the results of this research?

If you would like to receive a summary of the results, there will be a tick-box on your consent form to indicate your interest. Results will be emailed to participants privately.

What do I do if I have concerns about this research?

If you have any concerns regarding the nature of this project should be notified in the first instance to the project supervisor

Name: Sarah-Kate Millar

Email: sarahkate.millar.aut.ac.nz

Phone: 09 921 999 Ext 7667

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK, Kate O'Connor, ethics@aut.ac.nz , 921 9999 ext 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Name: Alana Coombe; Email: alanacoombe@hotmail.com

Project Supervisor Contact Details:

Name: Sarah-Kate Millar; Email: Sarahkate.millar.aut.ac.nz, Phone: 09 921 999 Ext 7667

Approved by the Auckland University of Technology Ethics Committee on 14-
september 2017 AUTEK Reference number 16/436

Appendix D: Consent Form

Project title: Investigating Coach Understanding of Tactical Skill in Netball.

Project Supervisor: Sarah-Kate Millar

Researcher: Alana Coombe

- I have read and understood the information provided about this research project in the Information Sheet dated 12/07/2018 I have had an opportunity to ask questions and to have them answered.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- I agree to take part in this research.
- I acknowledge that I will be given an opportunity to read and verify the transcripts that results from this study. I will be able to add any additional comments, or clarify what was said. I am interested in taking part in this part of the study Yes No
- I wish to receive a summary of the research findings Yes No
- I wish to be contacted to take part in future research that results from this pilot study No Yes

Participants signature:.....

Participants name:.....

Participants Contact Email

Date:

Approved by the Auckland University of Technology Ethics Committee on 18 November 2016 AUTEK Reference number 16/436

Appendix E: Tactical Principles Guideline.

Core game tactical principle 1: Space and movement	
Attacking tactical behaviours	Defensive tactical behaviours
<p>Protect space: Using the body to create and show a clear space to receive a pass for yourself or another player.</p> <p>Court balance: The effective positioning of players to use the width and length of the court.</p> <p>Decisive movement: The clear and purposeful movements of attacking players to create movements through the court.</p> <p>Draw or fake: The actions taken to direct defensive players away from a space or preferred passing option, to open it up.</p>	<p>Confuse space: Varied movement around an attacking player to open or close the space they have available to receive a pass.</p> <p>Attack the line of the ball: The actions of a defensive player to attack the path of the ball, away from the body of the receiver.</p> <p>Contest catch space: The actions of the defender to contest the space the receiver needs to cleanly receive a pass.</p> <p>Dictate movement: Defensive actions taken to force attacking players into an ineffective space on court.</p>
Core game tactical principle 2: Timing	
Attacking tactical behaviours	Defensive tactical behaviours
<p>Pace of ball: The purposeful use of varied type or timing of pass to deny the defender the ball.</p> <p>Getting free: The timing of attacking movements to be available to receive a pass in a clear space.</p>	<p>Delay and disrupt ball offload: Actions taken by a defensive player to slow down or disrupt ball release.</p>
Core game tactical principle 3: Support	
Attacking tactical behaviours	Defensive tactical behaviours
<p>Options to the ball: The attacking teams ability to create multiple passing options for the player in possession of the ball.</p>	<p>Defensive unity: The actions of defensive players to work together and adjust to each other's movements in relation to the opposition.</p> <p>Full team defence: The contribution of all players to create accumulated pressure.</p>
Core game tactical principle 4: Reading play	
Attacking tactical behaviours	Defensive tactical behaviours
<p>Option selection: The ability to make decisions that set-up the next stage of play.</p> <p>Space awareness: The ability of a player to read the spaces that are being created for them for accurate ball placement or to move into and use.</p>	<p>Reading patterns: The players awareness of repeated ball or player movements to anticipate the next pass or movement.</p> <p>Space awareness: The ability for a player to read the spaces that attacking players want to use.</p>

Appendix F: Participant Quotes from the Expert Coach Interviews.

In order to provide some context for the development of the tactical behaviour definitions in the TPG, a series of participant quotes are highlighted below. The defensive tactical behaviours will be focused on first, followed by the attacking tactical behaviours. It is noted that these definitions and quotes, include a lot of netball specific terminology. The glossary on page xiv, as well as the TPG video, linked in Appendix M, should aid in understanding this terminology. Each tactical behaviour definition is included in **bold type** below, with examples of quotes from the expert coaches. Each quote is labelled with a number (E1, E2, E2 etc.), which refers to the different experts.

Defensive tactical principles

Space and movement tactical principle

The defensive tactical behaviours in the space and movement tactical principle, include; confuse space, attack the line of the ball, contest catch space and dictate movement. These behaviours are used to prevent the attacking team from efficiently moving the ball through the court, which provides the defensive team with more opportunities to create turnovers.

Confuse space:

Varied movement around an attacking player to open or close the space they have available to receive a pass.

Defensive players confuse the space of attacking players who are trying to make themselves available to receive a pass. Therefore, when a defensive player confuses space, it is more difficult for the attacking player to know which space to pass into or use.

So say I was an attacker, and I had the defender marking me on one side, I might dodge a certain way... but if the player's loose and I can't find them it's a little bit harder for me to know which space to use...so a defender can be a little bit more loose and just confuse the space a bit more. (E4)

The above quote suggests that the 'looseness' of a defending player is used to confuse space. A loose defensive style typically refers to zonal or space marking (marking space rather than a player), which makes it difficult for the player in possession of the ball to

decide where to pass the ball. Confusing space can also be used by defensive players to make an attacking player look free to receive a pass.

Even stepping off a little to make it look like the GS is open, but enough so that she can step off, open her up, but come back in and go for the intercept. (E5)

When asked what this behaviour looked like, one coach emphasised the varied and continual movement.

There are times when it could look like players switching...to confuse, so confusing their opposition a little bit and a lot of movement and footwork and not standing still (E8)

Attack the line of the ball (ALOB):

The actions of a defensive player to attack the path of the ball, a way from the body of the receiver.

ALOB is typically seen in netball when a defensive player is attempting to gain an intercept. When using ALOB, the player will purposefully and directly run from their starting position, into the path the anticipated path of the pass.

You've definitely got those people that just won't give up and they really will just attack the ball. (E3)

Ah so it would look like on court someone you know...physically stretching out, going for an intercept, it might look like someone coming around someone...and trying to attack the ball...um just being ready to go for it really. (E8)

Contest catch space:

The actions of the defender to contest the space the receiver needs to cleanly receive a pass.

In contrast to ALOB where players attack the line or path of the ball (away from the body of the attacker), contest catch space requires defenders to be close to the body of the attacker who is about to receive a pass.

Defensively we look at where the attackers catch the ball, and attack the catch point of the pass...so there's gotta be a point of weakness of what she does, and so often if you attack where someone catches the ball, it kind of gets in your personal space, and so you force an error. (E1)

While contest catch space has been categorised into the space and movement principle, the tactical intent has links to the timing tactical principle, as highlighted in the quote below.

So something defensively that I always tell people to do, is attack the catch...attack them catching the ball and put pressure on the timing, because if we do that the whole way down the court...by the time it gets to the GK... they're going to get a brilliant intercept, it's actually the GS and GA's intercept because they have created this timing pressure and by doing that energy shifts, and a real sustained effort on pressurising people catching the ball. (E7)

Dictate movement:

Defensive actions taken to force attacking players into an ineffective space on court.

Through the interviews the coaches reinforced the idea that there are certain places on court that attacking players want to move into and use. One of the roles of a defender, is to force attackers away from the effective spaces.

Rather than just following your partner around the court and trying to stick with them...basically you're gonna keep them to an area and say 'no you're not allowed to come here', so your more kind of denying them the ball...and I guess that...for me that builds pressure on people when they're not allowed to go where they want to go on court. (E3)

Um, to use a bit of netball jargon...they would either be setting something up or they would be dictating to a point...and when I say dictating to a point, you know you might mark and attack on a certain side...to encourage her to go somewhere. (E9)

In order to dictate movement, defensive players must first be able to read the spaces that attacking players want to use. This 'reading of spaces' is captured in the reading play tactical principle

Yea for different opposition there will be different danger zones that you try and keep them out of...you know from a defensive point of view you try to push them away from. (E8)

Timing tactical principle

The tactical behaviours that are categorised under the timing principle relate to the ability of players to control of the speed or pace of the game. The defensive tactical behaviours in the timing principle, include delay and disrupt ball offload.

Delay and disrupt ball off-load:

Actions taken by a defensive player to slow down or disrupt ball release.

In netball, the 'three second rule' dictates the length of time the ball can be held for. Therefore, the player in possession of the ball must pass within three seconds of receiving a pass to avoid being penalised for a 'held ball'. The tactical behaviour delay and disrupt ball offload, is used by the 'on-the-ball' defender to force a held ball or a poorly placed pass.

The fact is you have to get someone over the ball to slow it down, so you need someone three feet over the ball so that that person doesn't have a clear view of the post...of where they want to pass it...you pressure that and get a defender on that so that your forcing the ball to go longer and on a diagonal angle. (E1)

Within the rules, players guarding the ball must be at least 3ft (or 0.9m) away from the player with the ball. Therefore, when adopting 'delay and disrupt' legally (i.e., to "get someone over the ball"), that player has to be 3ft away from the passer.

So like .9 ummm...vision block other people might call it...if your partner has the ball you would just put hands up, .9, to slow that ball down. (E5)

Therefore, in addition to slowing down the pass, defenders can disrupt the vision of the passer. Often, this creates pressure and results in a poorly executed pass. For example, coaches identified that a strong 3ft guard can force attackers to throw a 'loopy', slower pass, allowing a defender further down the court, more time to get into position for an intercept.

The ball will have a loop in it, so it will go up, and it will have a loop and it will come here which means the defender behind can attack the ball, and the balls in the air for longer. (E1)

This above quotes highlight the interconnectedness between of individual actions. The actions of one player; creating a strong 3ft guard, allows another player an intercept opportunity. This interconnectedness is incorporated in the support tactical principle below.

Support tactical principles:

The importance of teamwork is highlighted in the support tactical principle, which includes tactical behaviours that emphasise the interconnections needed between players for team success. The tactical behaviours include; defensive unity, and full team defence.

Defensive unity:

The actions of defensive players to work together and adjust to each other's movements in relation to the opposition.

Defensive unity describes how players work as a unit. For example, the actions of one player can create an opportunity for others, as highlighted in the quote below.

If you were doing a zone defence you're all creating something for somebody else, so you're not necessarily working for yourself, but the work that you do might create... a pass or an error that somebody usually behind you...would pick up the turnover. (E11)

The coaches also recognised that the success of the team requires an acknowledgement of a players role within the team, which helps players use defensive unity.

Um so what my role is as a GS defending, what my role is as a GK...Um....what my role is as a C....so having that real clarity around how do you participate to add to that to that unit work or that team work. (E2)

Full team defence:

The contribution of all players to create accumulated pressure.

Full team defence highlights the important role that each player can have on defence, as it is the accumulative pressure through the court, that can create turnover opportunities. Any players who is not defending, will essentially break the built up pressure and allow the attacking team to maintain possession of the ball.

It only takes one person not to do their job then the whole unit of defence will be...ineffective because you know it's one person out of place, or it's one person not quite doing their role...so having that real clarity on what your own job is, but also implementing it and being part of a unit. Which is really quite... two different things, but quite hard. (E2)

So having that real clarity around how do you participate to add to that unit work or that team work. Um...and what your job looks like...how it's implemented, and if you know...it only takes one person not to do their job then the whole unit of defense will be...ineffective (E2)

Reading play principle

Reading play can be thought of as the perceptual processes used to gather information from the environment to inform decision making. The defensive tactical behaviours within the reading play principle include reading patterns, and space awareness.

Reading patterns:

The players awareness of repeated ball or player movements to anticipate the next pass or movement.

The definition of reading patterns captures the information that defensive players observe and use to inform their decision making.

I guess for myself you were looking at a little bit...patterns...like might have happened before, so you notice that someone doesn't turn fully and look down court, their always only going to look sideways, so that allows you that confidence to um go for that kind of ball. (E3).

So... a defender who can read at the earliest possible moment that a cue is telling them that the player is going to do something, it's like um...a flat stance with their feet apart, or a jump in the air is telling the defender that the person can only go one way, so you know which way to move. (E1)

Space awareness:

The ability for a player to read the spaces that attacking players want to use

The space awareness tactical behaviour indicates that when defensive players can anticipate where attacking players want to move, they pre-emptively adapt their behaviour to restrict the attacking teams ability to use those spaces.

So... it's a rather than reacting to what the attackers doing, you're continuously moving into spaces where you know they'll want to go, so that you upset their timing and you put indecision in their mind. And what that does is it forces them to then go out wide, or come back out here and that's these are the pockets where you get really stuck, and you end up doing a really big wide angled pass back into the circle to feed. (E1)

Attacking tactical principles

The nine attacking tactical principles are presented next, with each tactical behaviour defined in **bold type** followed by examples of the quotes from the expert coaches that helped construct the definitions.

Space and movement tactical principle

The attacking tactical behaviours in the space and movement principle include; protect space, court balance, decisive movement and draw or fake. These behaviours are used to ensure the ball is maintained as it is moved through the court, as well as making it difficult for the defensive team to gain a turnover.

Protect space:

Using the body to create and show a clear space to receive a pass for yourself or another player.

The tactical behaviour protect space highlights how the body position of the potential receiver can communicate to the passer where to pass the ball. Specifically, the way the attacking player angles their body shows a space to pass the ball, that is away from a defender.

Yea getting free, creating space, but the passers having the ultimate say by putting the ball in the right place so that you're not involving an umpire or your putting it away from where the defence is...our responsibility then is for the receiver to do more to create that space, they can't mark you forever, you gotta do more work, you gotta do more prep. (E9)

This quote highlights that the player receiving the ball has to create space, away from the defender in order to show the passer where to pass the ball.

Court balance:

The effective positioning of players to use the width and length of the court.

As expressed by an expert coach “You need a balance... all netball is, is a manipulation of spaces” (E1). Therefore, when a team is balanced (using the length and width of the court), they have the ability to use and manipulate space.

If I think about that attacking wise, the court balance to make sure that you've got your...so if we broke the court into channels...so that you haven't got everyone in one channel. So, that balance is all about having each third balanced and each channel balanced. (E5)

Decisive movement:

The clear and purposeful movements of attacking players to create movements through the court.

In order for the passer to make good decisions about who to pass to, good quality information is needed. When attacking players off the ball use clear movements, this provides good information to the passer about where to pass the ball.

Then for through court attack, same sort of thing...so having court balance, timing, strong definite movements. (E5)

Yea your attacking team, so you're always looking for your players, your WA and GA especially, or one of WA or C has to be playing down court, deep in court. If those players are all offering up court, like this, that's when the defence has beaten them, because you've got no players penetrating past the attacking line of the ball (E1)

Draw or fake

The actions taken to direct defensive players away from a space or preferred passing option, to open it up.

The draw and fake tactical behaviour is made up of two components. The ‘fake’ aspect occurs when the player in possession of the ball ‘fakes’ a pass to trick the defender to move in one direction, but then quickly passes the ball in the opposition direction.

I would fake, I would pretend to pass... and you're manipulating... like she's just created a bit of space there, so I can fake to get her there and then place the ball over there, for my shooter. So, your manipulating. (E6)

In contrast the ‘draw’ aspect is used by an attacker not in possession of the ball. Again, the goal is to deceive the defender, so they are drawn away from a certain area, to free space to use.

So perhaps if you had a less experienced player on that you knew was not going to cope with the pressure of just...being out on the court, then you would use her as a decoy runner, not necessarily a ball carrier. So her role in it might just be to draw players out, to allow a more dominant player to come in and carry the ball up the court. (E5)

In this example, the 'decoy runner' is used to open up space by drawing a defender away, so that defender is unable to defend the space the attacking team wants to use.

Timing tactical principle.

The tactical behaviours that are categorized under the timing principle relate to the ability of players to control of the speed or pace of the game. The attacking tactical behaviours in the timing principle include, pace of the ball, and getting free.

Pace of the ball

The purposeful use of varied type or timing of pass to deny the defender the ball.

For the player in possession of the ball choices can be made about when and how to pass the ball. Pace of the ball, specifies both the type or timing of a pass. The type of pass refers to passes such as a chest pass (fast and flat), a bounce pass (slower and low to the ground), or a lob pass (slow and loopy).

Decision making by the attacker...for instance how long she holds the ball, um timing of release of pass, type of pass...she may do a bounce pass which obviously is the slower ball than if your given a straight one. (E10)

In contrast the timing of the pass refers to how long the attacker holds the ball for before passing (must be less than three seconds).

The variety of timing with the pass as well...so not all on the same second. So if you tend to go...boom, boom, boom, boom, it's likely that you'll be intercepted because it's really easy for the defence. (E4)

So, if your unpredictable with your timing and then you might go first second, third second, third second, first second...you know...sort of thing. Then it just creates that doubt into what you're going to do. (E5)

Therefore, when the type and timing of the pass is varied, it becomes harder for the defensive players to get the correct timing to know when to attempt to intercept the ball.

Getting free

The timing of attacking movements to be available to receive a pass in a clear space.

Another aspect of timing that is important is ensuring that players are available to receive a pass at the right time.

Then one of the things that might happen is a lack of timing and that would be around...in order to get free you need some time to get free, so when the person turns and is looking for someone to pass to, you should be open, but if you haven't started that work early enough, um you may not be...if you have started it too early you might have been closed down again. (E7)

So there are plenty of different ways...there's plenty of movements they can do...the dodges, your rolls...up to go backs...um holds...there's all sorts of things....um but also obviously that is a...it's timing related as well...so being available at the right time for the person with the ball. (E4)

Therefore, off-the-ball players need to ensure they 'do the work' (i.e. do different movements to get away from a defender) at the right moment that the passer is looking for someone to pass to.

Options to the ball

The attacking teams ability to create multiple passing options for the player in possession of the ball.

The coaches frequently identified, that having more than one option to pass to is vital for ensuring the attacking team maintains possession of the ball.

The other thing I think to prevent turnovers is always having more than one option to the ball. So, making sure that you have two options to the ball that you might have um... a front straight line, you might have a square option, and you've always got a safety in the back as well. So knowing that you have got those options if you get stuck that you can turn around and reset to pass the ball. (E5)

An ideal would be that there's not just one person that I can pass to, that I've got other options, so if that one closes down or I don't think I can get that ball or I don't feel confident with that ball, I've got more options. (E3)

So at all times the player who is holding onto the ball sees three people providing one of those options, now if you do that well, what it does is it manipulates space and makes the defence not know what option is going to get the ball. (E1)

Option selection

The ability to make decisions that set-up the next stage of play.

While having multiple options to the ball is important, it is equally vital that the passer selects the most beneficial option.

Um reading what's happening in front of you and then assessing the options...so ah you would have hopefully, you'll have sort of two or three options in front of you...and that's what we sort of aim for (A: Mmmhmm) um and it's reading which one is the best options, so that's that whole decision making process. (E4)

Space awareness

The ability of a player to read the spaces that are being created for them for accurate ball placement or to move into and use.

Space awareness is important for players both in possession of, and not in possession of the ball. Firstly, for the player with the ball, they must be able to read the spaces that are being created for them to pass into. For example, if a teammate is using the tactical behaviour protect space, the passer must be aware of that space.

There's some skill around reading where the available space is, and getting the ball to that space. (E7)

If the defender has got their hand to it first, then you put the ball in the wrong place. (E9)

It's really important that the person passing the ball places it in a really good point for the catcher to catch it, so they can turn on the ball and land facing the post. So that's the ultimate you're looking for on attack. (E1)

Space awareness is also important for players off-the-ball, as a passer may be aware of a free space, that they want to pass to, so the off-ball player must aware of the space to move into and use.

Appendix G: Study Two Ethics Approval.

18 July 2018

Sarah Kate Millar

Faculty of Health and Environmental Sciences

Dear Sarah Kate

Ethics Application: 18/279 Identifying team based tactical behaviour during critical game events: Validating the tactical principles guideline

I wish to advise you that a subcommittee of the Auckland University of Technology Ethics Committee (AUTEC) has approved your ethics application.

This approval is for three years, expiring 17 July 2021.

Standard Conditions of Approval

1. A progress report is due annually on the anniversary of the approval date, using form EA2, which is available online through <http://www.aut.ac.nz/research/researchethics>.
2. A final report is due at the expiration of the approval period, or, upon completion of project, using form EA3, which is available online through <http://www.aut.ac.nz/research/researchethics>.
3. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form: <http://www.aut.ac.nz/research/researchethics>.
4. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.

Please quote the application number and title on all future correspondence related to this project.

AUTEC grants ethical approval only. If you require management approval for access for your research from another institution or organisation then you are responsible for obtaining it. You are reminded that it is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard.

For any enquiries, please contact ethics@aut.ac.nz

Yours sincerely,



Kate O'Connor: Executive Manager

Appendix H: Study Two Participant Information Sheet

Date Information Sheet Produced:

12 July 2018

Identifying team-based tactical behaviour during critical game events: Validating the tactical principles guideline.

An Invitation

You have been invited to participate in a research project being conducted through the AUT Sports Performance Research Institute New Zealand (SPRINZ). This project is being undertaken by Alana Coombe, a PhD candidate from the Faculty of Health and Environmental Sciences. Alana is supported by Netball New Zealand to carry out this project.

Participation in this project will involve engaging in an online questionnaire for between 45-60minutes. This questionnaire will require you to watch short video scenarios of netball game play, and then answer a series of questions about each of the scenarios.

Please note, that under no circumstances will any identifying information be included in this report, and that participation is completely voluntary. There will be no adverse consequences if you choose not to participate. You may withdraw from this study at any time.

What is the purpose of this research?

Alana is undertaking this research for her PhD thesis at AUT-University. This research aims to validate a new tool that has been developed to define and identify tactical behaviour in netball athletes. With limited assessment protocol for tactical competency in netball, this research is anticipated to have a positive impact on the availability of coach education resources in New Zealand.

How was I identified and why am I being invited to participate in this research?

You have been invited to participate in this research given your involvement in Netball coaching at the required level. Your insight, experience and knowledge is seen as a valuable resource for this research. This research is directed for those coaching at Performance, and High Performance levels and all coaches who have been identified at this level, are being invited to participate.

How do I agree to participate in this research?

If you are interested in taking part in this research, you will be required to reply to Alana Coombe to register your interest. Formal consent procedures will take place once further instruction is provided online.

What will happen in this research?

Should you wish to take part in this research you will be asked to:

- Sign a participation consent form (online)
- Engage in a questionnaire
- It is anticipated this will last between 45-60 minutes.
- During this time, you will watch video scenarios, and use the tactical competencies tool that has been developed to identify tactical behaviour.
- You are able to stop the questionnaire at any time and your progress will be automatically saved. When you resume the questionnaire, you will continue where you stopped previously. Therefore, the questionnaire does not have to be completed all at the same time.

What are the discomforts and risks?

There is no discomfort or risks associated with this research.

What are the benefits?

Through participating in this research it is hoped that it will increase your knowledge around tactical skill development in Netball. You will also have a valuable role in shaping the rest of the Alana's' PhD, which is hoped to improve the resources that are available for developing tactical skill in Netballers across the development pathway. Your participation will therefore assist in the researcher obtaining her PhD.

How will my privacy be protected?

Your personal details will be kept confidential throughout the duration of this study. The questionnaire will be completed online with no identifying details recorded. Netball New Zealand will have no knowledge of whether you participated in this study or not.

What are the costs of participating in this research?

There are no monetary costs involved in the participation of this research. It is expected that your participation will require between 45-60minutes of your time.

What opportunity do I have to consider this invitation?

You have two weeks to consider this invitation. If you are interested in taking part, you must email Alana Coombe within this time to register your interest. Once you have agreed to take part, a link to complete the online questionnaire will be sent.

Will I receive feedback on the results of this research?

If you would like to receive a summary of the results, there will be a tick-box at the end of the online questionnaire for you to indicate your interest. Results will be emailed to participants privately.

What do I do if I have concerns about this research?

If you have any concerns regarding the nature of this project should be notified in the first instance to the project supervisor

Name: Sarah-Kate Millar

Email: sarahkate.millar.aut.ac.nz

Phone: 09 921 999 Ext 7667

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK, Kate O'Connor, ethics@aut.ac.nz , 921 9999 ext 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Name: Alana Coombe; Email: alanacoombe@hotmail.com

Project Supervisor Contact Details:

Name: Sarah-Kate Millar; Email: Sarahkate.millar.aut.ac.nz, Phone: 09 921 999 Ext 7667

Approved by the Auckland University of Technology Ethics Committee on 19 July 2018,
AUTEK Reference number 18/279

Appendix I: Study Two Consent Form

Title: Identifying team based tactical behaviour during critical game events: Validating the tactical principles guideline.

Project Supervisor: Sarah-Kate Millar

Researcher: Alana Coombe

- I have read and understood the information provided about this research project in the Information Sheet dated 12/07/2018
- I have had an opportunity to ask questions and to have them answered.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- I agree to take part in this research.
- I acknowledge that I will be given an opportunity to read and verify the transcripts that results from this study. I will be able to add any additional comments, or clarify what was said. I am interested in taking part in this part of the study Yes No
- I wish to receive a summary of the research findings Yes No
- I wish to be contacted to take part in future research that results from this pilot study Yes No

Participants signature:.....

Participants name:.....

Participants Contact Email

Date:

Approved by the Auckland University of Technology Ethics Committee on 18 November 2016 AUTEK Reference number 18/279

Appendix J: Study Three Ethics Approval

14 November 2018

Sarah Kate Millar
Faculty of Health and Environmental Sciences

Dear Sarah Kate

Re: Ethics Application: 18/279 Identifying team based tactical behaviour during critical game events: Validating the tactical principles guideline

Thank you for your request for approval of amendments to your ethics application. The amendments to the recruitment and data collection protocols is approved. Non-Standard Conditions of Approval

1. Remove legacy references to the online questionnaire from the Information Sheet

Non-standard conditions must be completed before commencing your study. Non-standard conditions do not need to be submitted to or reviewed by AUTEK before commencing your study.

I remind you of the Standard Conditions of Approval.

1. A progress report is due annually on the anniversary of the approval date, using form EA2, which is available online through <http://www.aut.ac.nz/research/researchethics>.
2. A final report is due at the expiration of the approval period, or, upon completion of project, using form EA3, which is available online through <http://www.aut.ac.nz/research/researchethics>.
3. Any amendments to the project must be approved by AUTEK prior to being implemented. Amendments can be requested using the EA2 form: <http://www.aut.ac.nz/research/researchethics>.
4. Any serious or unexpected adverse events must be reported to AUTEK Secretariat as a matter of priority.
5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEK Secretariat as a matter of priority.

Please quote the application number and title on all future correspondence related to this project.

AUTEK grants ethical approval only. If you require management approval for access for your research from another institution or organisation then you are responsible for obtaining it. If the research is undertaken outside New Zealand, you need to meet all locality legal and ethical obligations and requirements.

For any enquiries please contact ethics@aut.ac.nz

Yours sincerely,



Kate O'Connor
Executive Manager

Appendix K: Study Three Participant Information Sheet

Date Information Sheet Produced: 08/11/2018

Project Title: Investigating the Effectiveness of the Tactical Principles Guideline to Inform Tactical Competence.

An Invitation

You have been invited to participate in a research project being conducted through the AUT Sports Performance Research Institute New Zealand (SPRINZ). This project is being undertaken by Alana Coombe, a PhD candidate from the Faculty of Health and Environmental Sciences. Alana is supported by Netball New Zealand to carry out this project.

Participation in this project will involve engaging in an 15min coach education session (focusing on tactical behaviour) which will be followed by a game observation task which will require you to identify tactical behaviours during live game play. You will be asked to focus on your team of 10 players, and rate them for their tactical competency. This research will take place at the National development camp in January 2019.

Please note, that under no circumstances will any identifying information be included in this report, and that participation is completely voluntary. There will be no adverse consequences if you choose not to participate. You may withdraw from this study at any time.

What is the purpose of this research?

Alana is undertaking this research for her PhD thesis at AUT. This research aims to validate a new tool that has been developed to define and identify tactical behaviour in netball athletes. With limited assessment protocol for tactical competency in netball, this research is anticipated to have a positive impact on the availability of coach education resources in New Zealand.

How was I identified and why am I being invited to participate in this research?

You have been invited to participate in this research given your involvement in Netball coaching at the required level. Your insight, experience and knowledge is seen as a valuable resource for this research. This research is directed for those coaching at Performance, and High Performance levels and all coaches who have been identified at this level, are being invited to participate.

How do I agree to participate in this research?

If you are interested in taking part in this research, you will be required to reply to Alana Coombe to register your interest. Formal consent procedures will take place once further instruction is provided online.

What will happen in this research?

Should you wish to take part in this research you will be asked to:

- Sign a participation consent form
- Engage in a 15min coach education session where you will learn about the tactical principles guideline (an observation tool, developed to identify tactical behaviour).
- During the camp, you will be asked to watch your team members during game play (live) and rate each player on their tactical competency using the TPG.

What are the discomforts and risks?

There is no discomfort or risks associated with this research.

What are the benefits?

Through participating in this research it is hoped that it will increase your knowledge around tactical skill development in Netball. You will also have a valuable role in shaping the rest of the Alana's' PhD, which is hoped to improve the resources that are available for developing tactical skill in Netballers across the development pathway. Your participation will therefore assist in the researcher obtaining her PhD.

How will my privacy be protected?

Your personal details will not be collected during this study. Netball New Zealand will have no knowledge of whether you participated in this study or not.

What are the costs of participating in this research?

There are no monetary costs involved in the participation of this research. It is expected that your participation will require between your time during the camp.

What opportunity do I have to consider this invitation?

You have two weeks to consider this invitation. If you are interested in taking part, you must email Alana Coombe within this time to register your interest. Once you have agreed to take part, a link to complete the online questionnaire will be sent.

Will I receive feedback on the results of this research?

If you would like to receive a summary of the results, there will be a tick-box at the end of the online questionnaire for you to indicate your interest. Results will be emailed to participants privately.

What do I do if I have concerns about this research?

If you have any concerns regarding the nature of this project should be notified in the first instance to the project supervisor

Name: Sarah-Kate Millar

Email: sarahkate.millar.aut.ac.nz

Phone: 09 921 999 Ext 7667

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTECH, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Name: Alana Coombe; Email: alanacoombe@hotmail.com

Project Supervisor Contact Details:

Name: Sarah-Kate Millar; Email: Sarahkate.millar.aut.ac.nz, Phone: 09 921 999 Ext 7667

Approved by the Auckland University of Technology Ethics Committee on 14 November 2028, AUTECH Reference number 18/279

Appendix L: Study Three Consent Form

Project title: Investigating the Effectiveness of the Tactical Principles Guideline to Inform Tactical Competence.

- I have read and understood the information provided about this research project in the Information Sheet dated 08/11/18 or I have had an opportunity to ask questions and to have them answered.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I agree to take part in this research.
- I wish to receive a summary of the research findings
(please tick one): Yes No

Participant's signature:.....

Participant's name:.....

Participant's Contact Details (if appropriate):

Date:

Approved by the Auckland University of Technology Ethics Committee on 14 November 2018 AIJTEC Reference number 18/279

Appendix M: Tactical Principles Guideline Video

https://www.youtube.com/watch?v=J634NBj_6OY&list=PLGnj3eXfHMkGSMecXi4yrrgBU-gyGq-by&index=4&t=2s

Follow the link above to observe the TPG video. The coaches and selectors in study three were provided with this video to become familiar with the definitions in the TPG. To skip through the video and look at a specific tactical behaviour, go to the video link and click 'more' and select the tactical behaviour you want to learn more about.

Appendix N: NDC Coach Questionnaire

Q1. What is the highest level coaching role you have in the 2019 season? (Circle one)

ANZ premiership assistant / specialist coach, Beko League head coach, Beko league assistant coach, Regional/ national representative coach (U17, U19, U21 etc), Highschool or club team Other
(specify) _____

Q2 Were you allocated a Head coach or Assistant coach role at the NDC this year? (Circle one)

Head coach

Assistant coach

Q3 Have you had any experience completing a Netball NZ player profile in the past? (circle one)

Yes

No

Can't recall

Q4 Did you use the Smartabase system to load the Player Profile information? (circle one)

Yes

No

Q4a (answer if you said yes to **Q4**).

The Smartabase system was easy to use.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q6 The tactical behaviour definitions listed in the TPG were easy to understand?

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q6a Why do you believe the tactical behaviour definitions were not easy to understand?

(if strongly agree or disagree were selected for Q6.

You will now answer questions about how the TPG helped you identify tactical behaviours and provide feedback to players.

Q7 The tactical behaviour definitions in the TPG enhanced my ability to **identify** the players strengths and work-on's

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q8 I am confident **identifying** the tactical behaviours in the TPG

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q9 The tactical behaviour definitions in the TPG enhanced my ability to **provide feedback** to the players regarding their strengths and work-on's

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q10 I am confident **providing feedback** about the tactical behaviours in the TPG

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q11 The TPG captures the most important aspects of tactical behaviour.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

Q11a What aspects of tactical behaviour do you believe are missing from the TPG? (If strongly disagree or disagree was selected).

Q12 Have you got any further feedback?

Q13 Would you like to receive a summary of the results of this study? (Circle one)

Yes

No

Q14 If yes, please provide an email address to send the results to.

Appendix O: Tactical Principles Guideline App Prototype



Follow the link provided to watch a short video explaining the app.

<https://www.youtube.com/watch?v=Go2Dc6tNvrY&feature=youtu.be>