

**Cardiff School of Sport**  
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 Empirical <sup>1</sup>

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	<b>Title and Abstract (5%)</b>  Title to include: A concise indication of the research question/problem. Abstract to include: A concise summary of the empirical study undertaken.		
	<b>Introduction and literature review (25%)</b>  To include: outline of context (theoretical/conceptual/applied) for the question; analysis of findings of previous related research including gaps in the literature and relevant contributions; logical flow to, and clear presentation of the research problem/ question; an indication of any research expectations, (i.e., hypotheses if applicable).		
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**CARDIFF METROPOLITAN UNIVERSITY**

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**THE INFLUENCE OF RULE CHANGE ON ATTACKING  
STRATEGIES IN ELITE LEVEL WOMEN'S FIELD  
HOCKEY**

**(Dissertation submitted under the discipline of  
Performance Analysis)**

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**THE INFLUENCE OF RULE CHANGE ON ATTACKING  
STRATEGIES IN ELITE LEVEL WOMEN'S FIELD  
HOCKEY**

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## **Abstract**

Rule changes have become a common facet within modern day sports and as such carefully calculated and researched assessments are required in order to recognise the influence of such changes. The present study investigated the affect that the self – pass rule change had upon utilised attacking strategies within elite level women’s field hockey. Twelve (n=12) elite standard women’s field hockey matches were analysed and assessed in order to help identify any key changes caused by the rule change. In order to aide data collection, the hockey pitch was split into 12, utilising the pitch markings to assist the creation of identifiable zones. Furthermore the circle was then split into 3 zones, ensuring that it was possible to classify the exact areas of circle penetration. These zones were created in order to ensure that the results collected met the initial aims set out within the study. Results suggest that across both sets of data the most common play restart method is that of a free – hit, although considerably less were awarded in 2012, signifying the fact that the advantage rule is being played more often by umpires in order to increase the potential of the sport from a spectators viewpoint. A grand total of 965 self –pass instances were recorded, with a gargantuan 67% occurring within the attacking half, supporting the theory that the self – pass has become a staple part of the game as it is now played. Furthermore a significant difference of  $p < 0.018$  was recorded within zone classification, signifying that the self – pass rule change has led to an increase in the speed of play. It was concluded that the self – pass rule change has had a varied impact upon the sport of field hockey, with certain aspects being affected more than others as a result of the introduction. The results are specifically beneficial to those who work within an elite level performance setting. Additionally the coded antecedents allow for a developed understanding as to how teams attack through the utilisation of the self – pass.

CHAPTER I  
INTRODUCTION

## **1.1 Overview of Field Hockey**

Hockey is a team sport, widely acknowledged as a 'field invasion' game, much like soccer (Reilly & Borrie, 1992). It is viewed as a fast paced and highly skilled game that places particular importance on the application of maintaining possession through accurate passing, whilst aiming to ultimately outscore the opponent (McMorris, 2004). According to Anders and Myers (2008), within the past decade participation rates of both genders have significantly increased, supporting the growing use of performance analysis within hockey as there is a desire to perform as effectively as possible. Performance analysis enables the coaches and players to identify effective aspects of performance, as well as those which require further attention.

## **1.2 Background to Research Problem**

Sporting events are governed by pre – determined sport specific rules, adopted in order to ensure that the game is played under controlled and authoritative conditions which can provide a winner. Without the provision of these rules it would be impossible to differentiate between any sports as the rules of a sport effectively give it its identity. Eaves, Hughes and Lamb (2008) stated that the rules of any one sport seldom remain unchanged for an extended period of time, due to the need to refresh the sport, further promoting it to a wider audience. As a direct result of the continued adaptations to sports, varying styles of the same game have come into being. 'Fastnet', an adapted version of netball was presented in 2009, with the purpose of making the game more viewer centred. Gibson (2009) identified that it is hoped that this version of netball will be included in the 2020 or 2024 Olympic Games. Other variations of sports now in the public domain include rugby sevens and Twenty20 cricket. Much like 'Fastnet', Twenty20 cricket (Lemmer, 2008) allows new challenges to present themselves to players and coaches alike.

Gardiner, Felix, James, Welch and O'Leary (1998) maintained that external sources, such as sponsors and the media are the main influencing factors regarding rule changes in sport. Williams (2008) also acknowledged the prevalence of the role played by media in the advancement of rules, thus upholding the view of Gardiner et al., (1998). Williams (2008) furthered understanding of why rules are changed within modern day sports, stating that both safety and natural progression play a pivotal role. Numerous studies using performance analysis have been conducted encompassing the influence held by rule changes in sport, ranging from Rugby League (Eaves et al., 2008; Meir, Colla & Milligan,

2001) to Beach Volleyball (Giatsis, 2003; Ronglan & Grydeland, 2006) and Water Polo (Lozovina & Lozovina, 2009).

The International Hockey Federation (FIH) is responsible for the introduction and implementation of rules within hockey. The hockey rules board is tasked with presenting the FIH with potential changes, although the absolute decision lies with the FIH as to which rules to accept or reject. Many rules which have recently been included have undergone a trial process to assess the effectiveness of the rule in achieving its provisional aim.

Rule changes have become more frequent with some effects being observed immediately, whilst others have taken longer to embed themselves within the fabric of the game. An example of the immediate effects of a rule change can be seen in the abolition of the offside rule. The hope was that more goal scoring opportunities would present themselves and they did as teams adapted their attacking strategies to best exploit this change. On the other hand the rule which meant that defenders could score own goals (2012), will be removed as it was perceived by the FIH as being detrimental to the game, specifically at lower levels as it detracted from the use of skill encouraged by the FIH.

The introduction of the self - pass rule dramatically altered the way in which a free hit could be taken. The player who was taking the free hit was able to play the ball to themselves, permitting that they made two distinctive motions to signal the taking of the hit. This change increased the speed with which the game is played (Tromp & Holmes, 2011) as another facet of the rule stipulates that the defending players cannot engage the ball carrier if they were within 5 yards of the taking of the hit. Defenders must retreat the required distance before they can make a play for the ball (FIH Rules of hockey, 2009). Further changes occurred as a result of the rule change, for example any free hits awarded within the 25 yard area are required to not immediately enter the circle, instead they must move 5 yards before this is a possibility. The aim of this was to reduce the element of danger present from simply hitting the ball straight into the circle. If the offence occurred within the 25 yard area it is required to be moved out of the area before the free hit can be taken. Empirical evidence for the effect of the rule change is limited, as only one study conducted by Tromp and Holmes (2011) has looked into such an aspect, therefore providing a justification for the undertaking of this study.

### **1.3 Purpose of Study**

The overall purpose of the present study is to consider the influence that the self – pass rule change has had on attacking strategies within elite level women’s field hockey.

#### Specific Objectives

- Establish whether or not there is a difference in attacking strategies employed within the two samples.
- Ascertain the areas which see more circle penetrations.
- Effectively compare the results of both samples.

### **1.4 Hypotheses**

A total of twelve games, six from each of two tournaments, four years apart were investigated for the effects held by the self – pass rule change. When conducting analysis, the following hypotheses were tested:

- H<sub>1</sub> There will be more self passes that occur within the attacking half.
- H<sub>2</sub> The most common area for circle penetrations across both samples will be from the right hand side.
- H<sub>3</sub> Locations of successful outcomes will be largely initiated from the attacking half of the pitch.

### **1.5 Limitations of the Study**

As all games were recorded from television coverage, some incidences were unavailable for analysis due to the inclusion of television replays. Various aspects that have the ability to affect performance levels and patterns of play, such as score line were not considered. Furthermore the time and word limit restricted the depth of analysis that could be presented.

### **1.6 Delimitations of the Study**

The findings of this study are only relatable to elite level women’s field hockey. As such the results may not hold true for lower level women’s hockey or men’s hockey. In addition the sample only comprised of twelve games, consequently reducing the strength and applicability of the results.

# Chapter II

## Literature Review

## 2.1 Performance Analysis

According to Bartlett (2001) performance analysis can be explained as a merging of biomechanical and notational analysis; however, further research conducted by Hughes (2004) suggested that it is in fact extremely difficult to place a fixed definition upon what exactly performance analysis entails.

Notational analysis is used to record performances in which events can be calculated in a reliable manner, allowing accurate qualitative and quantitative feedback to be given to whoever requires it (Carling, Williams & Reilly, 2005; Hughes & Franks, 2008). Within performance analysis there are known to be two varying types of notational systems in which the analysis can be completed; hand notation and computerised notation (Hughes & Franks, 2008).

Hand notation systems are created manually by the researcher with the intention of being proficient in analysing certain aspects of performance (Hughes & Franks, 2004). The main benefit to using hand notation within sport is that it is cheap to conduct, meaning that any team, even at grassroots level, can experience the potential of performance analysis. It is also beneficial as analysts can hand over recorded data to the coach at half time, allowing the coach to address where improvements need to be made. Despite this, there are also weaknesses displayed when utilising hand notation systems, the main one being that as demand for performance analysis increases, so does the required quantity and quality of information. The amount of information required for an effective analysis has become more complex, leading to data processing taking longer, essentially negating the main benefit of hand notation (Hughes, 1993). Furthermore, through increased demand for more detailed analysis of performance, it is possible that hand notation will soon become impossible to administer.

Despite the previous statement, the world renowned sport of American football currently has a complete ban on the use of computerised systems during matches as a way of relaying information to coaches and players (Hughes & Franks, 1997). This has resulted in the continued use of hand notation systems as a form of analysis and as such argues against the idea that hand notation is now impossible to apply within sport, particularly at an elite level.

In order to combat the problems being faced by hand notation systems, computerised systems such as Studiocode and Coda (Sportstec Limited, Warriewood, Australia) were created. Toledano, Garcia and Godoy (2001) understand that these systems were created in order to help coaches and analysts interpret data more efficiently. Hughes and Franks (2004) identified five specific reasons to use computerised analysis instead of hand notation; the provision of immediate feedback, the development of large databases, immediate indication of areas which required addressing, effective and accurate performance evaluations and the provision of a mechanism which allows for selective searching through video recordings. The provision of these suggestions, courtesy of Hughes and Franks (2004) support the statement provided by Toledano et al., (2001) that refers to computer analysis being more effective.

Both hand notational and computerised analysis is used in order to help improve sporting performances through the provision of feedback, both on a team and individual basis. Analysis involves generating relevant coding systems in order to break down either aspects of a performance or the performance as a whole. Upon completion of the coding, accurate feedback can be constructed and given to those concerned.

In recent years performance analysis has become more widely applied throughout sport and it is commonly accepted that hockey is the third most popular sport in terms of participant numbers, behind soccer, but ahead of other respected sports such as rugby and cricket (Boddington, Lambert, Gibson St Claire & Noakes, 2001), thus resulting in the application of performance analysis at elite levels of the game.

Unambiguous and relevant performance indicators must be identified in order to enable the conduction of a succinct analysis. Hughes and Bartlett (2002) defined a performance indicator as an amalgamation of variables that define some or all aspects of performance. O'Donoghue (2010) expanded on this notion by stating that performance indicators are essentially variables that are demonstrated to be valid measures of performance.

It is imperative that the identified performance indicators are clarified before analysis, as they are critical to the success of the applied analysis system. For example, an effective performance indicator within hockey would be that of the success rates of shots on target. Each performance indicator identified within any given study may require analysis of more games than another, allowing the mean value of execution to stabilise (Hughes, Evans & Wells, 2004).

Validity of provided performance indicators is essential in terms of distinguishing between successful and unsuccessful events that occur during a sequence of a specific game (Hughes & Bartlett, 2002). The issue of validity is concerned with the extent to which a variable can measure its supposed concept, whilst also considering the importance that the concept has within the study (Morrow Jr, Jackson, Disch & Mood, 2005; O'Donoghue, 2012). Further research conducted by O'Donoghue (2008) emphasised the importance of accurately defining key performance indicators for analysis.

## **2.2 Attacking Strategies in Sport**

Sport has become heavily reliant upon the application of performance analysis, especially when evaluating attacking strategies and patterns of play employed by teams in various sports such as; Badminton (Hong & Tong, 2000; Tengku, Tengku & Saidon, 2006) and Football (Hook & Hughes, 2001; Hughes & Snook, 2006). Due to the ever changing nature of sports it is imperative that research is conducted continuously with regards to how attacking strategies and patterns of play change over periods of time or as the result of rule changes within the sport.

Football is viewed as one of the most widely renowned sports and as a result has often been the subject of extensive quantitative research, specifically surrounding aspects of patterns of play (Japheth & Hughes, 2001; Luhtanen, Belinskij, Häyrinen & Vääntinen, 2001; Scoulding, James & Taylor, 2004; Yiannakos & Armatas, 2006; Armatas, Yiannakos & Sileloglou, 2007). Up to date research is required in order for teams and individuals to be successful in implementing new attacking strategies and patterns of play (Thomas & Nelson, 2002).

The European Football Championship has been subject to a multitude of research in previous years (Hook & Hughes, 2001; Hughes & Snook, 2006; Yiannakos & Armatas, 2006). Hook and Hughes (2001) investigated patterns of play that led to shots on goal, whilst also considering the repossession methods applied in order to initiate these shots, using both successful and unsuccessful teams within the analysis. The study focused upon assembled data from the 2000 European Championships. The criteria for analysis set out that the four teams who made it to the semi-finals were successful, whereas the remaining eight were deemed unsuccessful. The ascertained results showed that those successful teams created more shooting opportunities, specifically from possessions that occurred within their own defensive half. Contrastingly, the unsuccessful teams often attacked for shorter time periods, resulting in more long shots being taken. Subsequently

this meant that those unsuccessful teams scored less goals, leading to their elimination from the tournament.

Hughes and Snook (2006) expanded upon research conducted by Hook and Hughes (2001) through the application of a larger analysis process when concerned with goals scored during the 2004 European Championships. Furthering this, the analysis also looked into repossession strategies employed by teams in relation to the attacking plays they administer. Hughes and Snook (2006) determined that successful teams started their attacks in the attacking third through breaking down the defending team high up the pitch whilst creating space allowing for shots to occur closer to the goal. These findings are similar to those ascertained by Hook and Hughes (2001) and as such only serve to bring research more up to date, as opposed to providing new ideas surrounding how to attack more efficiently.

Initial investigations into the attacking strategies and patterns of play implemented by field hockey teams ascertained that it was more commonplace for shots to come from the right hand side of the circle, despite the fact that results showed shots taken from the left hand side had a higher success rate (Andrews, 1985; Hughes & Billingham, 1986; Wilson, 1987). It was discovered that two teams that finished within the top four of the 1987 Women's Hockey Champions Trophy, held in Amstelveen, Netherlands, employed a strategy which required them to attack predominantly from the left hand side of the circle. In addition, it was noted that more circle entries occurred through the right hand side of the circle (Wilson, 1987). Wilson (1987) utilised the CASE system (The Computer Assisted Sports Evaluation for Field Hockey) in order to accurately quantify all gathered data, thus increasing the reliability of the recorded results. Despite the obvious benefits to the game delivered as a result of this research it is noted that the research is somewhat dated and therefore limited in its relevance (Thomas & Nelson, 2002). Furthermore the study conducted by Andrews (1985) only collected data from five games and as such is not fully representative of all games from that era. Since Andrews's (1985) and Wilson's (1987) publications an array of rule changes have been implemented within hockey, some of which having had a more evident affect upon the sport and the way in which it is played.

## 2.3 Rule Changes in Sport

Some of the first known performance analysis research encompassing the effect rule changes have on sports was conducted based around three specific sports; Football, Basketball and Hockey (Kew, 1987). It was identified within the study that the purpose of the rule change was to create and maintain an interest within the sport concerned. As a result of the importance of maintaining an interest, several adapted versions of other sports have come into existence, most recently; Fastnet (Netball), Twenty20 Cricket (Lemmer, 2008) and Rugby Sevens (IRB, 2010). The analysis conducted as part of the study found that the analysis was beneficial to coaches as well as players as it enabled them to gain a better understanding of how they can be the most effective within any given situation. Rule changes, such as those drawn upon in this study often take time to take affect and become prominent through all levels of the sport and as such research is sparse in certain sports, especially in the sport of Field Hockey. This view is supported by Williams, Hughes and O'Donoghue (2005) who consider there to be a lack of notational research surrounding the affect rule changes have on a sport. Since this paper was written an array of research has been conducted in relation to rule changes that have occurred within many different sports, ranging from Beach Volleyball (Giatsis, 2003; Ronglan & Grydeland, 2006) to Rugby League (Eaves et al., 2008) and the affects they have had on various aspects of the sports, with specific attention being paid to attacking patterns of play. It was the aim of the above mentioned studies to consider if rule changes to the sport in question are either of benefit or detriment.

Within beach volleyball Giatsis (2003) conducted a study focusing upon the effect that rule changes based around score fluctuation and match duration had on FIVB women's beach volleyball. The data was collected from 22 FIVB tournaments over a period of time that incorporated the rule changes. A significant difference between the two varying scoring systems was identified through the further application of a Post Hoc Scheffe test. The results suggested that scoring system changes increased the mean duration of beach volleyball games, increasing the spectacle of the sport. The findings of this study are potentially relatable to the self – pass rule change in hockey as the applied rule changes have changed the dynamic of beach volleyball, much like the self – pass has within hockey. The previous statement is supported by results across sports (Tromp & Holmes, 2011). Although this study furthers understanding within beach volleyball it is again limited in its relevance to all levels of the sport as it only considers women's beach volleyball,

whilst insinuating that the results are applicable to men's beach volleyball. For this to be proven further research is required.

There is also additional research based around the effect of rule change within elite level beach volleyball, with specific focus placed upon male teams (Ronglan & Grydeland, 2006), as opposed to women's teams (Giatsis, 2003). The aim of the study was to investigate whether or not the identified rule changes had had an impact upon the quality of varied game actions at an elite performance level. Three FIVB World Tour tournaments (Norway Open, Portugal Open and the Austria Open) were used to gather the required data, although only the game actions of winning teams from the semi – finals and finals of these tournaments were considered. A total of 34 games were analysed, 17 prior to the rule changes and 17 afterwards. The quality of an action was not assessed against standardised criteria, but instead against the outcome of that action (Hughes & Bartlett, 2002; McGarry & Franks, 2003). Significant differences were to be pinpointed through the application of a Mann Whitney test. Results showed there to be a substantial diminution in the efficiency of the serve and attacking plays within the sample generated after the rule changes. These amendments required teams to adapt the strategies and tactics they employed in order to remain successful whilst abiding by the new rules. Although this research furthered understanding it is not without limitation. Some of the strategies being employed by teams as a result of the new rules were already being applied within indoor volleyball, thus reducing the appearance of significant results within outdoor volleyball. This leads to reduced applicability in terms of the generated results.

## **2.4 Rule Changes in Hockey**

The International Hockey Federation (FIH) is entirely responsible for the transformations seen within Field Hockey in the past decades. The Hockey Rules Board suggest changes such as the introduction of the own goal rule (2013) and present them to the FIH who ultimately decide whether or not to sanction their inclusion. It can be inferred that specific rule changes have a greater impact upon the sport, specifically the removal of the offside rule (FIH Rules of hockey, 1998) and as a direct result the game of Field Hockey as it is now is exceptionally different. Further to the above mentioned rule change additional changes have occurred in more recent times, centring on potential improvements to sport safety as the game becomes more technically and tactically astute. For example maximum bow specifications of the stick were decreased in an attempt to reduce the danger and power with which some individuals were 'drag flicking' the ball (2006) as well as preventing players from playing the ball on the forehand edge of the stick, meaning that players were

required to develop differing ways in which the pass could be achieved (2007). Technical rules have also been adapted and clarified such as the deletion of a rule that up until the 2004 season prevented players from taking more than one forward step to perform a penalty stroke.

Sunderland, Bussell, Atkinson, Alltree and Kates (2006) conducted a study based upon the patterns of play and goal scoring within International level women's field hockey. The study hypothesised that more goals would come from attacks down the right hand side and from right sided entries, whilst more shots would come as a result of left sided attacks. The hypothesis was tested through the application of three analysis stages; phase of repossession, pass into the D and finally the D phase. The applied method required the use of three tournaments; the 2000 Women's Olympic Qualifying Tournament (Milton Keynes, UK), the 2000 Olympic Games (Sydney, Australia) and the 2002 Commonwealth Games (Manchester, UK). A grand total of 130 goals scored in open play were included within the analysis. The results generated from the recorded data found that the majority of repossessions occurred within the attacking half, but importantly, outside of the circle. This would imply that analysts should recommend coaches promote the application of a high press within the opponents half, forcing defensive turnovers. Moreover it was discovered that more balls were dribbled into the circle (50%) than were pushed (28%), hit (21%) or swept (1%). Sunderland et al., (2006) proved their hypothesis correct as they found that more entries into the circle came from the right hand side of the pitch, within the attacking 25. Although the study and its result help develop a greater understanding of patterns of play displayed within International women's hockey it is to be noted that the data is now outdated as new rules have recently been introduced and as such the relevance of the patterns of play identified as part of the study is questionable in relation to modern day hockey. Furthermore, there is a question over the validity of the study due to the fact that it doesn't compare successful methods for goal scoring against the attempts made. The negligence of this factor minimalises the context presented within the study.

The most current research in relation to the effect that rule changes have had on modern day hockey was conducted by Tromp and Holmes (2011). Tromp and Holmes (2011) considered the effect that rule changes surrounding free hits had upon patterns of play and match variables displayed within international women's hockey. The aim of the study was to test the intention of the identified rule change and to ascertain whether or not the intention was met. The applied method required the analysis of 28 international standard games which took place during the 2008 and 2009 Champions Trophies, held in

Monchengladbach, Germany and Sydney, Australia respectively. A total of 14 games from each tournament were used in order to form the basis of the analysis. Upon completion of coding the data a Mann-Whitney test was conducted within SPSS, with the sole intention of identifying significant differences between the two samples.

Results showed that due to the rule change, the average time taken to initiate a free hit sequence decreased drastically when comparing the two samples (8.0 + 0.9 s in 2008 compared with 4.6 + 0.3 s in 2009). Whilst a notable decrease is displayed it can be seen that the findings of this study in relation to areas of repossession concur with results generated as part of Sunderland et al., (2006) study, despite the self-pass rule change being an option.

Tromp and Holmes's (2011) study displays marked similarities to a study completed by Williams, Hughes and O'Donoghue (2005). The influence that rule changes had upon ball in play time within rugby union were considered within the aforementioned study. Tully (2003) unearthed a rule change in hockey that caused a significant negative impact with regards to the safety of players. It wasn't until the 2007 season that a further rule was introduced to negate the new threat of injury. According to Williams et al., (2005) safety was a major influencing factor that was considered as part of the proposed rule changes. These studies display that safety, as identified by Williams (2008) is an extremely important aspect across all sports. Governing bodies such as the FIH will only enforce new rules if they deem them to not have a negative impact upon the safety of the players, or the natural progression of the game.

## **2.5 Summary**

In summary the collated research enables an accurate and consistent assessment of how the rule change has affected the attacking strategies employed by elite level women's field hockey teams. Despite this it is essential to acknowledge the distinct lack of available literature based upon the influence that the self – pass rule change has had on the game of hockey. Further research is undoubtedly required, with specific reference as to how the rule change has been incorporated within the attacking strategies displayed by teams.

Through a developed understanding of previous relevant research it can be hypothesised that a distinct difference between attacking strategies employed in 2008 and 2012 will be evident, as the influence of the self – pass rule change in 2009 will have taken full effect after 3 years of inclusion as a full part of the game. The present study will draw upon

research conducted by Tromp and Holmes (2011), in order to accurately accept or reject the hypothesis.

It is also perceived that the results generated upon completion of this study will be beneficial to the FIH in that it can shine light on exactly how the rule change has changed the game, specifically whether or not the aim of the rule change has been achieved from a statistical standpoint. Additionally the results may help the FIH understand whether or not the rule change has improved hockey as a spectacle.

## Chapter III

### Methods

### **3.1 System of Notation**

A computerised notation system was used in order to ease the process of collecting data (Hughes, 2008), thus helping to ensure that the collated data was interpreted as effectively as possible, considering the performance indicators identified. Sportscodex (Sportstec, Warriewood, Australia) allows elements of a performance to be paused and rewatched, leading to the enrichment of attained results.

### **3.2 Equipment**

Varying equipment was required in order to effectively undertake the project, including:

- Toshiba Portable 1TB External Hard Drive
- SanDisk – USB Drive
- Apple iMac PC with SportsCode installed
- Windows PC with IBM – SPSS (V20) installed
- A Toshiba Satellite L755D – 10J Laptop with Microsoft Word installed; along with access to internet

### **3.3 Sample**

The data used for the analysis of the self – pass rule change was attained from two different International standard hockey tournaments, which took place four years apart. Six games from the 2008 WorldHockey Champions Trophy (n=6), held in Mönchengladbach, Germany and six games from the 2012 Olympics (n=6), held in London, England were utilised for analysis (Appendix A).

These specific tournaments were selected as they were deemed to be the best for creating an effective comparison, due to the simple fact that both tournaments featured teams at the peak of elite level women's field hockey. The new self-pass rule was introduced at the beginning of the 2009 season, meaning that the 2012 tournament was played under contrasting rules to the sample taken from the 2008 tournament, allowing for an effective comparison. At the level of competition selected for analysis it was anticipated that the full effects of the rule change will be seen as teams at this level are more likely to look to gain the slightest advantage over their opponents in any way possible due to the games fiercely competitive nature.

Video footage was acquired from the Centre of Performance Analysis (CPA), based at Cardiff Metropolitan University, with permission to use the footage under the stipulation that it would not be used for any purpose other than the one stated. Ethical approval for the completion of the study was ascertained from the University Ethics Committee prior to the commencement of data collection.

### 3.4 Operational Definitions

Operational definitions clearly defining the performance indicators used within the analysis were required in order to ensure that the performances were accurately coded throughout. Problems that are associated with reliability often come from ambiguous and unclear operational definitions (Hughes & Franks, 2008).

**Table 1.** Operational definitions for attacking play.

Successful Outcomes	Unsuccessful Outcomes
An entry made by the attacking team into the defending teams 25 yard area, leading to a positive outcome occurring.	An entry made by the attacking team into the defending teams 25 yard area, leading to a negative outcome occurring.

**Table 2.** Operational definitions for play restart methods

Potential method	Definition of method
Free – Hit (Self – Pass)	The ball is moved to a position close to the original offence. As of the 2009 season a free hit could be initiated through hitting, pushing, slapping or dribbling the ball.
Long Corner	Occurs when the defender accidentally plays the ball over the baseline. Ensures attacking team maintain possession (FIH, 2011).
Side – line	The ball is retained by the attacking team as a defending player has caused the ball to travel out of play, anywhere the side of the pitch, excluding the baseline.
16 yard hit	Awarded to the defending team when the ball goes out of play over the baseline with the final touch off of an attacker. Play is restarted from where the ball went over the baseline, sixteen yards forward of it. (Anders & Myers, 2008)

**Table 3.** Operational definitions for successful attacking outcomes

Potential Outcome	Definition of Outcome
Successful Pass	Occurs when a player plays the ball to a teammate without losing possession of the ball.
Successful Dribble	When a player keeps the ball under their control, whilst moving in varying directions.
Shot on Target	When an attacking player plays the ball towards the goal, forcing the goalkeeper to prevent a goal.
Short Corner	The attacking team inject the ball from the baseline to just outside the circle, with the aim of scoring. The attacking team can choose the side in which the injection occurs (Anders & Myers, 1999).
Goal	When the ball is touched within the circle by a player from either team, which ends with the ball fully crossing the goal line (FIH, 2011).

**Table 4.** Operational definitions for unsuccessful attacking outcomes

Potential Outcome	Definition of Outcome
Unsuccessful Pass	Occurs when a player makes a pass which doesn't reach its intended target.
Unsuccessful Dribble	Occurs when a player loses control of the ball whilst running with it.
Tackle	When a defending player legally wins possession of the ball from an attacker (England Hockey, 2011). Also occurs when a defending player makes contact with the ball in a defensive motion, forcing the ball off of the pitch.
Interception	Possession is regained through the defender collecting the ball from a poor pass by the attacking player. (England Hockey, 2011).
Foul	When a player violates a rule for which the infringement is punishable. Leads to the concession of a free – hit.
Shot Wide	Occurs when a player takes a shot within the circle, which ultimately goes off of the pitch without threatening the goal.

**Table 5.** Operational definitions for zone grading

Potential Zone Grading	Definition of Zone Grading
Zone Upgrade	The ball travels forwards from one zone to another. Can only occur if ball is being played in a forward motion.
Zone Downgrade	The ball travels backwards from one zone to another. Only occurs if the ball is being played in a backward motion.

### 3.5 Pilot Study

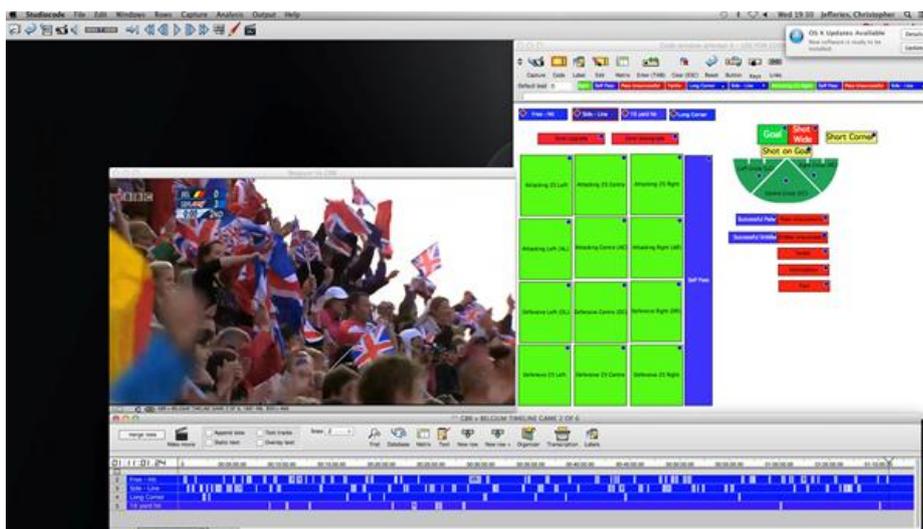
A pilot study was conducted using one half of a match between Argentina and the USA, independent of those games being analysed as part of the main study. The study was intended to test the suitability of the proposed analysis system. O'Donoghue (2010) stated that the purpose of conducting a pilot study is to assess any key issues that a system may experience, prior to the commencement of data collection. Half a match was coded to underline any possible discrepancies in terms of operational definitions or methods of data collection that could have appeared over the course of the match. Upon completion of the pilot study it was identified that several buttons that would help to provide a more detailed and effective analysis had been omitted; specifically buttons that differentiated between the award of a free – hit, long corner, side – line or 16 yard hit. These additional buttons were deemed necessary as the self – pass rule can also be applied to these events. Furthermore text labels detailing interceptions and tackles made by the defending team were required in order to show how a move ended when the attacking team lost the ball (Appendix B). Sportscodex (Sportstec, Warriewood, Australia) was used to conduct the analysis as it is regarded as the most reliable package when analysing changes in patterns of play (Davidson & Trewartha, 2008; Eaves & Broad, 2007).

### 3.6 Code Window Design

Through the development of a relevant code window it was possible to analyse the required performance indicators. In order to produce a relevant code window a number of buttons were required, each programmed in various ways.

Four code buttons were created in order to ensure that all relevant instances were mapped out. Each button was created to represent an instance, as seen in Figure 1. Code buttons are easily identifiable by the green diamond that appears in the top right hand corner of the button. A two second lead time was applied to each of these buttons in order to capture the instances effectively. The button entitled free – hit was included in order to accommodate the fact that the study was looking at how often the self – pass option was applied by teams during the 2012 sample as opposed to the staple free – hit required in the 2008 sample.

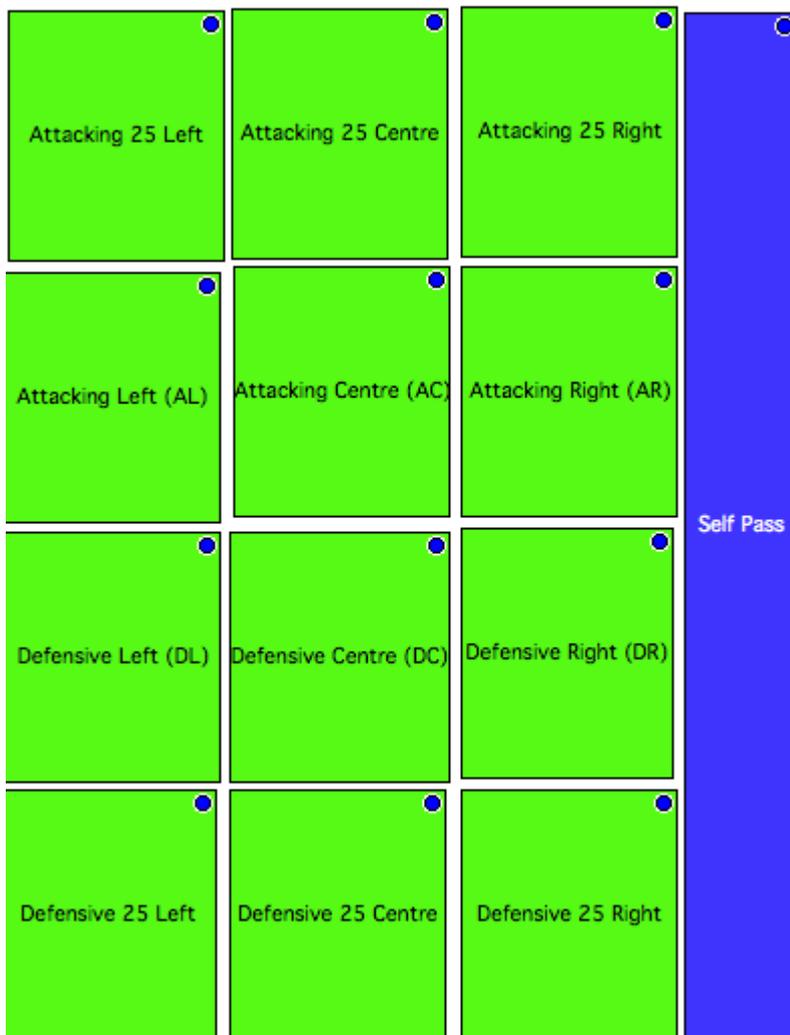
Furthering this, text label buttons were employed in order to accurately log the sequence of actions that occurred during each recorded instance of a self – pass, be it from the site of an offence or from a side line or long corner. A blue circle is visible in the top right hand corner of any button that is created as a text label in order to prevent confusion. Such buttons can be seen in Figures 2 and 3.



**Figure 1.** View of the applied code window

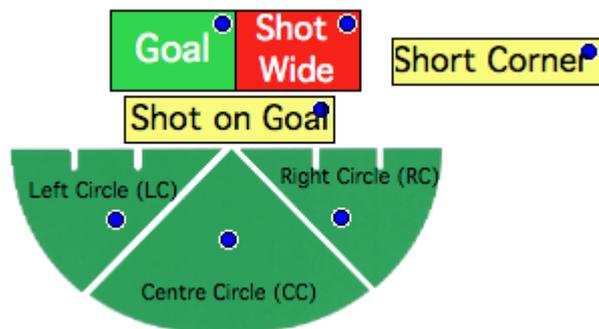
In order to effectively categorise the location of each self – pass, the pitch was separated into a 12 sectored matrix (Figure 2). The defensive half was split into 6 zones, each of which are represented by corresponding titles, for example; 'AL' representing the zone on the attacking left of the pitch from the halfway line up to, but not including the 25 yard line. The attacking half was also split into 6 zones accompanied by relevant titles, for example;

Attacking 25 centre which represents the attacking centre of the pitch between the baseline and the 25 yard line. Coding began when play was reinitiated, up until the point at which that period of play ended.



**Figure 2.** Attacking area pitch matrix

Additionally, the circle was split into 3 zones in order to accurately identify the area and manner in which the circle was penetrated. For example, if the circle was penetrated from the right hand side, the coding button 'RC' was to be applied (Figure 3).



**Figure 3.** Circle penetration matrix

Sportscodex (Sportstec Limited, Warriewood, Australia) was used to analyse the footage required as it allows all requirements of the study to be met, within a user friendly environment. Sportscodex as a programme is not explicitly available to a specific sport and as a result has been used within a variety of studies, such as beach volleyball (Pérez – Turpin, Cortell – Tormo, Suárez – Llorca, Chincilla – Mira & Cejuela – Anta, 2009). The package allows footage to be fast forwarded, meaning that it is possible to reduce the amount of time required to code each game. Furthermore, the package allows the footage to be paused and resumed as the operator sees fit. This means that the operator can ensure correct data is recorded. As this study is specifically looking at the implementation and effect of the 2009 self – pass rule it can be inferred that the ability to fast forward the footage to relevant incidents is beneficial to the timescale around data collection.

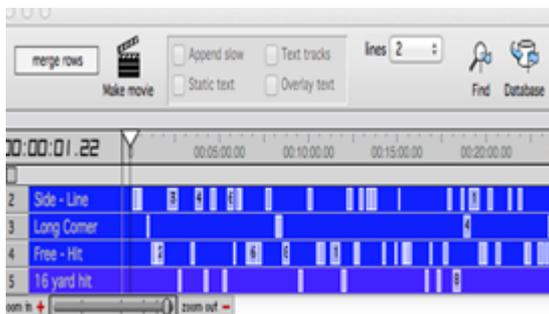
### 3.7 Data Collection Procedures

The games used for analysis were stored on an external hard drive and then opened with a new timeline and appropriate code window. As the code window was created for the purpose of analysing multiple games across years which incorporated rule changes, no changes were required prior to coding. The order in which the events were notated remained consistent throughout the coding process:

1. Play restart method (Free – hit, Side-line, Long Corner, 16 yard hit)
2. Area in which the event occurred
3. Was a self – pass used to initiate play
4. Skill performed
5. Was the skill successful or unsuccessful
6. If successful did the team upgrade/downgrade zones
7. If unsuccessful end coding instance

8. If a zone upgrade/downgrade occurred repeat from step 2 of this procedure, until the final outcome is evident.

All coded data is represented within a timeline, allowing the operator to view codified data within a coding matrix. The matrix was then exported from Sportscode into Microsoft Excel in order to conduct the first stage of data analysis.



**Figure 4.** Sportscode timeline

### 3.8 Data Analysis

Upon completion of coding the collated data was exported to Microsoft Excel in order to prepare it for further analysis using SPSS 20.0.1 (outputs in Appendix C). As the data was identified as being of a non – parametric nature, a Mann – Whitney U test was conducted in order to assess the levels of significant differences between the 2008 and 2012 data as the rules each competition was played under differed vastly. Once the data had been analysed in SPSS, output sheets were generated. Any differences shall be tested against a significance level of  $p < 0.05$ . Any identified differences need to be tested for in order to allow the original hypothesis to be accepted or rejected.

### 3.9 Reliability Testing

Reliability is ultimately concerned with the repeatability and consistency of results (Hughes, 2004; Thomas & Nelson, 1996). Testing allows for the validation of the notational system applied. On two occasions, with a lapse time of one week, the same 35 minute period of play was viewed as part of an intra-operator reliability study. The lapse time was applied in order to ensure that the agreement was not affected through recall memory or operator training and maturation. The decision was taken to conduct an intra – operator reliability test in order to ensure there was consistency within the coding, as suggested by Vincent (1999).

**Intra – operator reliability test:** 35 minutes of Korea v Belgium from the 2012 Olympics, Pool A.

It was determined that Kappa would be the conducted reliability test. Robinson and O'Donoghue (2007) stated that Kappa evaluates the reliability of performance indicators, applied within computerised systems. Altman (1991) initially applied Kappa in order to assess the reliability of assessments in medicine; however Kappa has become widely used within performance analysis in order to help ascertain the reliability of identified performance indicators through the use of computerised systems. Altman (1991) expressed that Kappa values range from between 0.0 and 1.0. O' Donoghue, Hughes, Rudkin, Bloomfield, Cairns and Powell (2005) conveyed the idea that a negative Kappa value could be used to display significant operator disagreement. Each indicator and descriptor of the previously mentioned chain of notation was subjected to a Kappa evaluation in order to ascertain the level of agreement held by the intra – operator agreement.

**Table 6.** Interpretation of kappa values (Altman, 1991).

<b>Kappa</b>	<b>Strength of agreement</b>
$\kappa \geq 0.8$	Very good
$0.6 \leq \kappa < 0.8$	Good
$0.4 \leq \kappa < 0.6$	Moderate
$0.2 \leq \kappa < 0.4$	Fair
$\kappa < 0.2$	Poor

### 3.9.1 Reliability Test Results

The kappa results provided in Table 7 illustrate that of the five variable groups; three resulted in an agreement of 1, which, according to Altman (1991) represents a 'very good' strength of agreement.

**Table 7.** Expression of kappa reliability scores

<b>Variable</b>	<b>Kappa Value (<math>\kappa</math>)</b>	<b>Strength of Agreement</b>
Play Restart Method	1	Very Good
Area of Event Occurrences	1	Very Good
Application of Self – Pass	0.97	Very Good
Zone Classification	0.90	Very Good
Final Outcome	1	Very Good

There are various explanations as to why the generated values are not all classified as having a Kappa agreement of 1. Human operators are deemed to make many different measurement errors throughout the observation and coding process, which has an effect on the ascertained kappa values (O'Donoghue, 2007). James, Mellalieu and Hollely (2002) acknowledged that along with operator errors, both definitional and observational errors also occur. Definitional error occurs when an operator is inconsistent with the application of an identified definition, whereas observational error occurs when an event is coded, but the operator didn't delete the instance, thus affecting results. It can be inferred that the Kappa value for 'Zone Classification' has been subject to definitional error as at points in the coding the operator may have perceived the restart method to have occurred in a slightly different area.

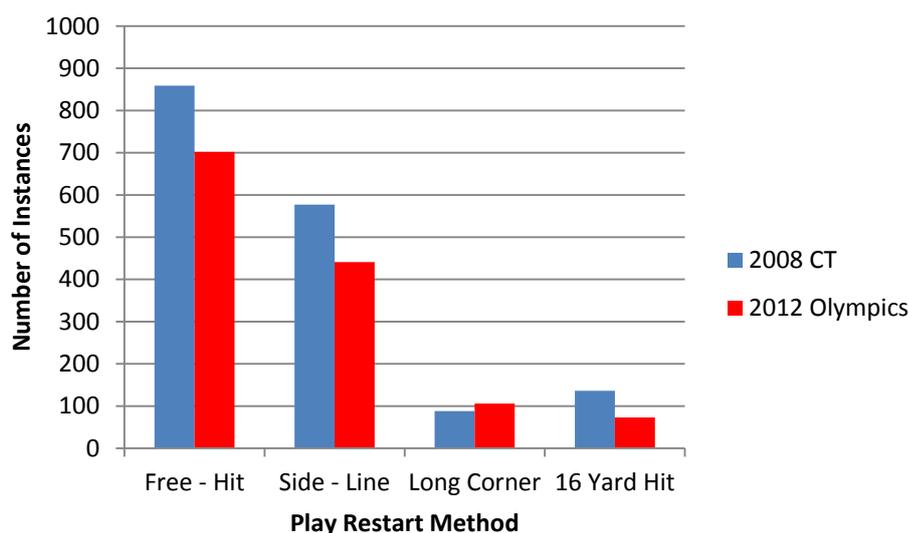
## Chapter IV

### Results

## 4.1 Introduction

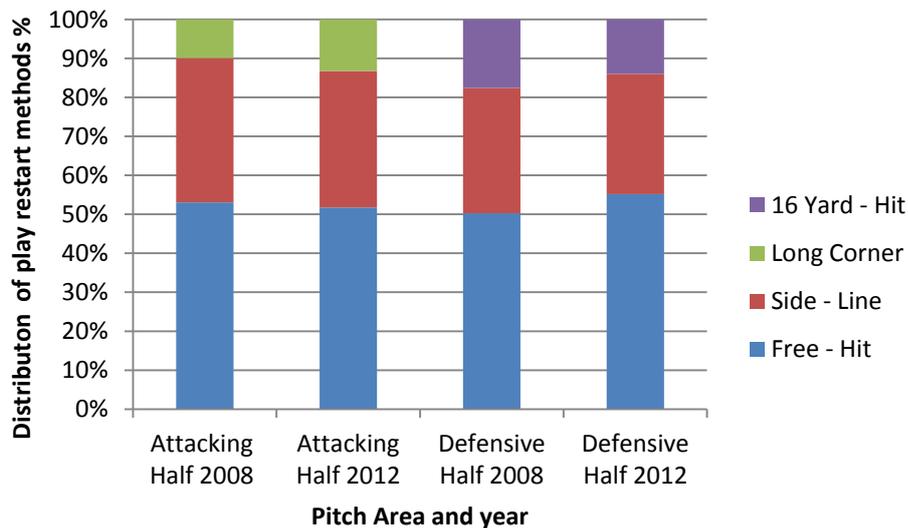
This chapter seeks to accurately present acquired data, with specific reference to the collated data for each of the identified variables. The results are exhibited through a selection of table and graphical formats, having also been statistically analysed within SPSS 20.0.1. When applying a Mann Whitney U – Test any significant differences established are denoted against a level of significance ( $p < 0.05$ ). The conduction of this statistical test will enable the researcher to clearly indicate whether or not any of the applied variables demonstrate significant differences.

## 4.2 Play Restart Phase



**Figure 5.** Comparison of play restart methods

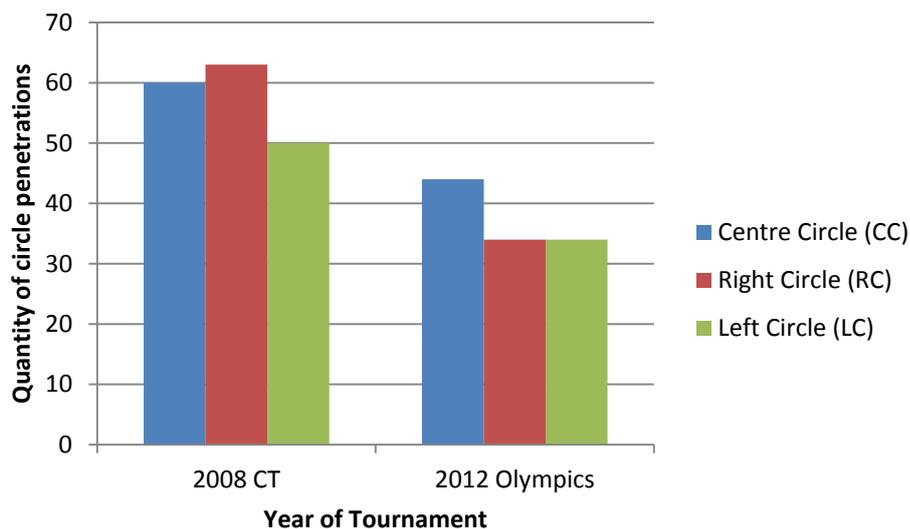
Results displayed within Figure 5 suggest that during 2008 more breakdowns in play were restarted by either a Free – Hit, Side – Line or 16 Yard Hit, whereas in 2012 more instances occurred whereby play was restarted through a long corner. Upon completion of a Mann Whitney U Test no significant difference was identified between the two samples ( $p < .000$ ).



**Figure 6.** Comparison of play restart method by pitch area

Within Figure 6 multiple differences can be seen between the two sets of data. Initially it is visible that more defensive plays were initiated by virtue of free – hits within the 2012 sample against the 2008 sample.

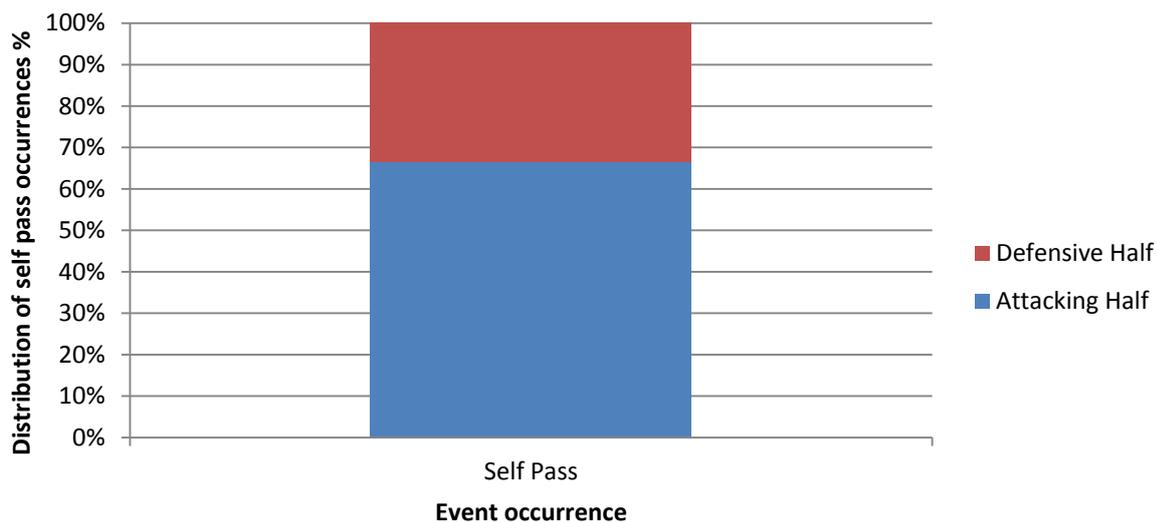
#### 4.3 Area of Event Occurrences



**Figure 7.** Comparison of circle penetration by zone

Figure 7 shows that, despite the inclusion of the self – pass rule more circle entries occurred during the 2008 Champions Trophy, although this does not consider the outcomes of those entries. It is also visible that there is more of a stable split between circle penetrations during 2012 as opposed to 2008.

#### 4.4 Self – Pass Applications



**Figure 8.** Location of self – pass occurrences

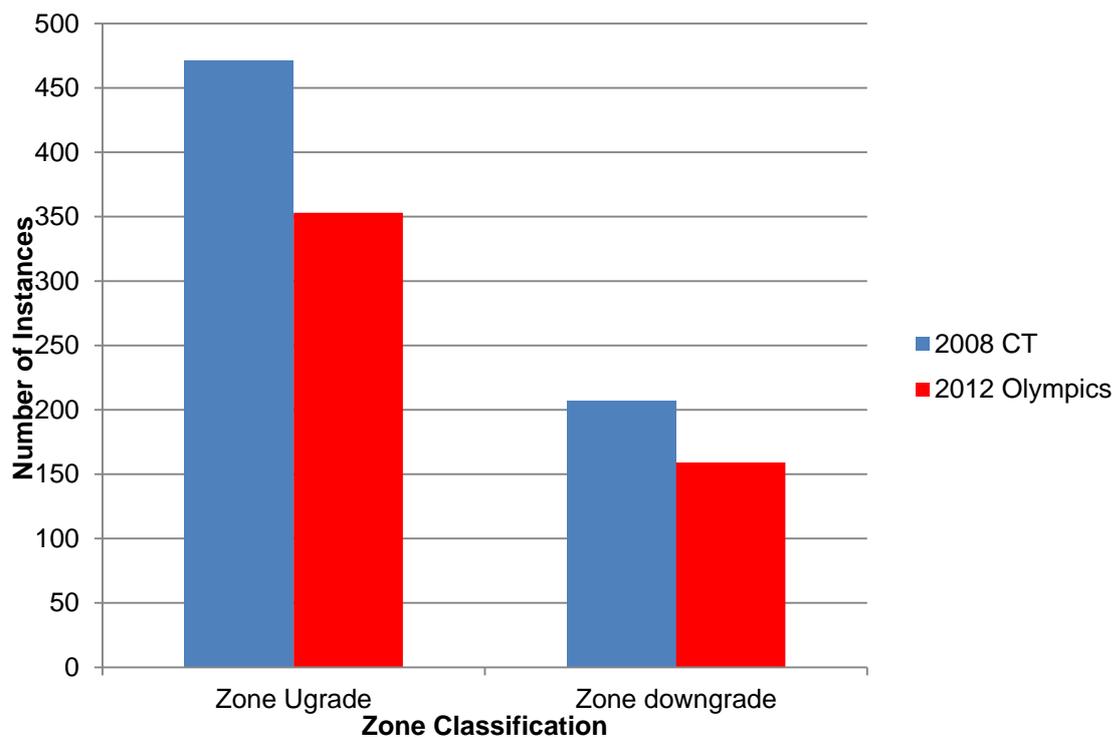
Figure 8 shows that a larger proportion of self – passes are used within the attacking half of the pitch. The results shown support the earlier hypothesis which stated that more self – passes would be employed in the attacking half of the pitch.

**Table 8.** Breakdown of self – pass location

Area of pitch	%	N
Attacking 25 Centre	2.4	23
Attacking 25 Right	21	202
Attacking 25 Left	13.2	128
Attacking Centre	4.4	42
Attacking Right	11.4	110
Attacking Left	10.2	98
Defensive 25 Centre	4.6	45
Defensive 25 Right	4.0	39
Defensive 25 Left	3.8	37
Defensive Centre	6.9	67
Defensive Right	10.4	100
Defensive Left	7.7	74

It is visible within the above table that the most common area whereby the self – pass is utilised is the attacking 25 right area. Furthermore it is established within that the right hand side of the pitch is the area where most self – passes occur, regardless of the zone. The only area in which the right hand side is not the most popular place for a self – pass it the defensive 25 centre. This is due to the fact that the majority of 16 yard hits are taken from the central zone of the defensive 25 in order to enable teams to spread the play wide, disrupting the opponents defence (Anders & Myers, 2008).

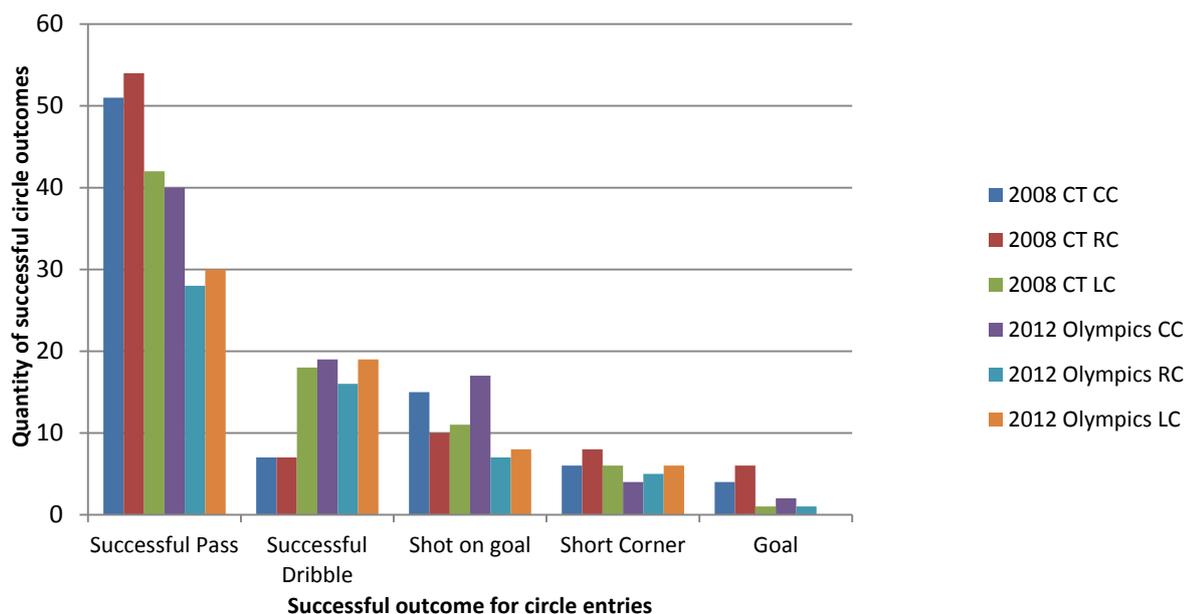
#### 4.5 Zone Classification



**Figure 9.** Zone classification comparison

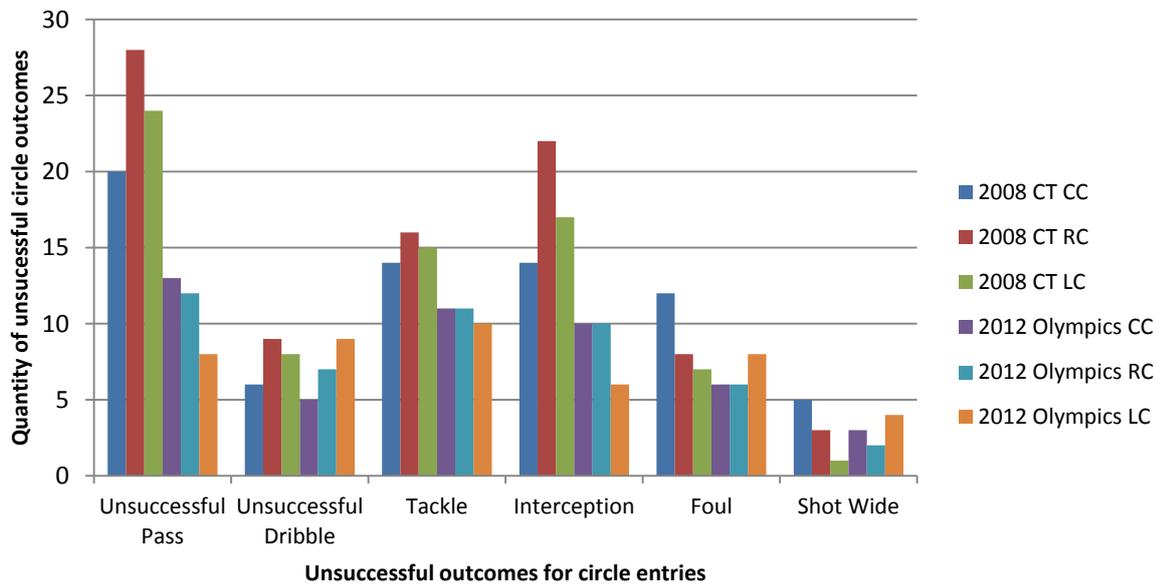
Figure 9 illustrates that there is a distinct difference between the two data sets in relation to the number of times that teams played the ball either forward or backwards. After the conduction of a Mann Whitney U Test, a significant difference of .618 was established.

## 4.6 Attacking Outcomes



**Figure 10.** Comparison of successful outcomes within identified circle zones

Figure 10 demonstrates all collated successful outcomes in relation to those that resulted in the penetration of the circle. 'CC', 'RC' and 'LC' represent the zone in which the outcome occurred both in Figures 11 and 12. It can be seen that more successful passes were made during the 2008 tournament; however there was a marked increase in the number of successful dribbles recorded during the 2012 tournament.



**Figure 11.** Comparison of unsuccessful outcomes within identified circle zones

Figure 11 highlights the collected data for all unsuccessful outcomes, relating to circle penetrations. It can be seen that there are less unsuccessful outcomes recorded as part of the 2012 Olympics which would suggest teams have found more effective ways in which to attack and penetrate the circle. Additionally it is worth considering the impact held by the way in which the sport is perceived by the viewing public. Umpires are beginning to become more lenient in the sense that they look to play the advantage rule as often as possible, preventing the sport from being branded ‘as exciting as synchronised swimming with chopsticks’ (Wein & McBryde, 1998).

# Chapter V

## Discussion

## **5.1 Introduction**

The objective of the study was to provide up-to-date and modern statistics in relation to the influence that the self – pass rule change (2009) has had upon attacking strategies within modern day contemporary women’s field hockey. The aim of this chapter is to explore the results displayed and discuss the implication of them in relation to the overall aims of the study. The results presented allow for the influence of the self – pass rule to be assessed, whilst demonstrating if there are clear differences between the attacking strategies employed between the two data sets.

The generated results have made it possible to present up to date data surrounding the influence of the self – pass, whilst demonstrating clear differences in applied attacking strategies between two sets of data. Due to a scarcity of research in the area of the self – pass rule change and its effect on attacking strategies, the ascertained results are relatable only to a restricted quota of studies, specifically that of Tromp and Holmes (2011).

## **5.2 Discussion of Findings**

### **5.2.1 Play Restart Methods**

The results exhibited in Figure 5 show that, similarly to Tromp and Holmes (2011), free hits are a regular occurrence within both samples. This form of play restart is unlikely to change in relation to its influence within the game. Although free – hits are a mainstay of the game of hockey, Figure 5 also displays a slight decrease in the quantity of awarded free hits, implying that as the years have progressed, so has the tolerance of umpires. This is likely due to the increased interest and media coverage of the sport (Gardiner et al., 1998; Williams, 2008). Additionally from the reduction in the award of three of the four restart methods it can be inferred that the ball is in play for longer durations, whilst as previously mentioned the advantage rule is being applied as often as required. Furthermore, Wein and McBryde’s (1998) article discovered that within the wider community field hockey was being referred to as “as exciting as synchronised swimming with chopsticks”, due to the shortage of shots on goal, coupled with the application of complex rules resulting in too many whistles occurring in any given game. Through developing an understanding of the importance of the free – hit within hockey specific emphasis can be placed upon coaches setting aside time within sessions to work on well-rehearsed set piece routines, incorporating the free – hit aspect. Through placing specific focus on how to best exploit the new self – pass rule available at free hits in terms of

potential execution strategies, teams at all levels; specifically the elite level should see a visible increase in the number of positive outcomes, which is directly relatable to goals being scored. This ideology is further supported through the fact that there are more positive outcomes that occurred within the 2012 data set (Figure 10), specifically surrounding the execution of successful dribbles into the circle.

From the results presented within Figure 6 it can be assumed that more fouls were committed from an attacking perspective which further stipulates that ball speed around the circle has increased, causing loss of possession and poor attempts to regain the ball in an attacking area. Additionally it is visible that long corners have become more commonplace within hockey as the years have progressed. This is supported by the results which display an increase in the award of total long corners (Figure 6).

### **5.2.2 Application of the Self – Pass**

Figure 8 and Table 8 reveal the distribution statistics accrued from analysis of all awarded self – passes. Figure 8 clearly displays that the attacking half experiences the most applications of the self – pass rule (66.42%), compared with 33.58% which occurred within the defensive half. Through performing a large percentage of self – passes within the attacking half it can be surmised that teams aim to utilise the self – pass in order to quickly gain field position, with the intention of penetrating the circle wherever possible. A deeper analysis of the exact field positions of the executed self – passes (Table 8) shows that the attacking 25 right area was used more than any other zone. This suggests that teams often look to attack down the right hand side of the pitch, as this is where they are at their strongest in relation to ball carrying position (Anders & Myers, 2008; Hughes & Billingham, 1986), whilst the defending team are at their weakest as it is harder to tackle an opponent who is driving at the reverse stick side. Due to this extended tackling difficulty more free hits are awarded due to basic infractions made by the defending team (England Hockey, 2008). This further justifies the results which suggest that more self – passes are executed on the right hand side as more tackles are made there, resulting in higher quantities of free hit, long corner and side line awards. Furthering this it can be seen within Table 8 that as a whole there are considerably more self – pass executions that occur on the right hand side of the pitch, again suggesting that teams prefer to keep the ball on the right hand side throughout the attacking phase, sometimes opting to transfer the ball around the back to the left hand side to change the focus of the attack, causing an imbalance within the defensive unit (Anders & Myers, 2008). The above mentioned findings are in keeping with those of Tromp and Holmes (2011) who also discovered teams preferred to attack down

the right hand side of the hockey pitch. It is worth noting that whilst the left hand side sees considerably less self – pass applications than the right, it is a more popular than the central zones. This is likely due to the fact that defending teams look to protect the middle and defend the ‘line to goal’ (Anders & Myers, 2008). This further supports the notion that teams look to attack from wide positions, resulting in more self – pass executions from either side of the pitch, excluding the central zones. Despite the fact that teams often look to attack from wide areas it can be seen in Figure 10 that the centre circle zone is in fact the most effective in terms of goal scoring. Through this it can be assumed that defending teams are more than happy for teams to attack them from wide, they primarily wish to protect the middle of the pitch as there is less immediate threat from teams attacking from wide, and again this can be seen within Figure 10.

### **5.2.3 Zone Classification**

Figure 11 displays a significant reduction in relation to the number of times a zone upgrade or downgrade is performed. It can be seen that during the 2008 tournament more zone upgrades and downgrades were coded. From this it can be inferred that during 2008 hockey was a more possession based game than it is today as teams would look more at protecting the ball, whereas, due to the introduction of the self – pass rule there is more of an emphasis on moving forward at speed. The significant difference of .618 generated through the application of a Mann Whitney U test supports the statement suggesting that the game is more possession based.

The above findings fit into established research surrounding the self – pass rule in the sense that the main aim of the self – pass rule was to encourage free flowing hockey, allowing teams to maximise any generated momentum. Tromp and Holmes (2011) found that the time taken to initiate a free hit almost halved, from  $8.0 \pm 0.9$ s in 2008 to  $4.6 \pm 0.3$  s in 2009. From this it can be deduced that, in keeping with those findings, teams have looked to move the ball forward as quickly as possible, leading to a visible difference between zone upgrades and zone downgrades, specifically within 2012. Through this it can be further inferred that the previously mentioned rule change has reached its intended aim. The application of free flowing hockey gives a huge advantage to the attacking team, as all defenders are required to retreat at least five metres in order to be able to engage the ball carrier should they employ the self – pass. This requirement makes it easier for teams who have been fouled against to move the ball forward zones at a much more rapid

pace. This emphasises teams' wishes to create drastic pressure upon the defending team by stretching the play, forcing them into defensive mistakes (Anders & Myers, 2008).

#### **5.2.4 Outcome of attacks**

Following the integration of the self – pass rule in 2009, there has been a visible shift in the outcomes of all attacks, therefore signalling the potential for implementing various attacking strategies. This would suggest that the self – pass has had an impact on the methods of circle entries since its 2009 introduction. Fewer goals were recorded as a result of open play during the 2012 tournament, although short corners catered for the majority of goals. The new rules have caused a mixed bag of results in relation to the changes caused within the modern day contemporary game of field hockey.

Firstly, there has been a marked alteration in the overall contribution of side- lines within the game of field hockey. During the 2008 tournament a total of 577 side – lines were recorded, whereas during the 2012 tournament only 441 side – lines were recorded. The reduction in the award of side – lines has seen an increase in the number of awarded long corners (88 in 2008; 106 in 2012). Through this it can be inferred that more attacking plays are reaching the defensive baseline, whereas before the self – pass rule introduction the majority of attacking plays were being stopped around the attacking 25 central area. From this data it can be deduced that the game has become more attacking orientated since the rule change, thus increasing the potential excitement for spectators (Gardiner et al., 1998). It is visible within Figure 6 that the most common method of play restart is from a free hit, regardless of the area on the pitch in which it is awarded. The final outcome of the method of play restart is significantly affected by the application of penetration by the attacking team. Anders and Myers (2008) maintain that penetration occurs only through effective application of width and depth. It is clear from observation of all games, regardless of the year that elite level teams look to employ both depth and width in attack, in order to stretch the play, thus causing a defensive imbalance. Within each game when in possession of the ball the attacking teams would have at least one player holding back in order to enable them to switch the play, thus justifying the evident split between the left and right zones in relation to self – pass applications (Table 8). Through having a player who sits deep defensively, acting as a pivot, additional time on the ball is created for the attacking team, again affecting the zones in which each play restart method occurs.

Tromp and Holmes (2011) identified that preceding the self – pass rule change; most circle penetrations resulted in the ball being lost to the defending team. Whilst this is ultimately still the case, it is clearly visible that due to the reduction in circle penetrations, there has been a decrease in the number of unsuccessful circle penetrations (Figure 11). It can be surmised that through the reduction in circle penetrations shown within this study, the restriction placed upon the entrance of the ball to the circle from anywhere inside the 25 yard area has achieved one aim whereby the safety of players has been improved, through the prevention of the often applied ‘crash’ ball. The majority of circle penetrations acknowledged within 2008 were as a result of such a pass into the circle, leading to high quantities of turnovers occurring within the circle. The most common form of unsuccessful outcome in 2008 was that of an unsuccessful pass, closely followed by interceptions, therefore supporting the theory that the ‘crash’ ball was operated on numerous occasions. Through drawing direct comparisons with the 2012 sample it can be seen that there was a drastic reduction in the number of unsuccessful passes, showing that teams were looking for more effective ways to penetrate the circle, as opposed to looking for a lucky bounce or roll of the ball onto say an opposing defenders foot, leading to the award of a short corner or penalty flick.

Other than Sunderland et al., (2006) there is a scarcity of research into specific patterns of play within field hockey, although as previously mentioned there is a large quantity of research surrounding this aspect within football (Hook & Hughes, 2001). Hook and Hughes (2001) found that interceptions were a common method for repossession by successful teams, whilst further findings showed that unsuccessful teams used more direct styles of play and longer passes with a smaller percentage success rate. These findings are applicable to the current study in that they agree with the results which suggest interceptions are a popular method which lead to unsuccessful outcomes within the circle.

Figure 10 displays each and every successful outcome of circle penetrations. It is clear to see that during 2008 passing was the most successful way in which to enter the circle, although this aspect did experience a reduction in the 2012 sample. Contrastingly there was a distinct increase in terms of successful dribbles causing a penetration into the circle, leading to support the view that the self – pass rule has encouraged more skills, as encouraged by the FIH. Figure 11 also shows that the majority of entries into the circle during 2008 occurred from the right hand side of the circle, whereas there was more of an even split in terms of circle entries during 2012. Findings agree with previous research (Andrews, 1985; Sunderland et al., 2006), whom noted that the right hand side incurred

the most entries prior to rule changes. Further association in terms of agreement can be drawn with Tromp and Holmes (2011) who found that with the applied rule changes, specifically the self – pass, circle entries were more evenly spread across all zones, as also suggested by Doiron (2004). The provision of such findings denotes that the introduction and abolition of certain rules within the game have had varied impacts upon generic patterns of play within elite level field hockey. It should be duly noted that the right hand side is still the superior side in terms of executing entries into the circle as it is the strongest side for the attackers, whilst being the weakest for defenders (Figure 11).

### **5.3 Strengths**

Both the pilot and reliability studies provided an opportunity for the system of analysis to be applied twice before being used within the main study. This enabled the observer to familiarise with the system. As a result it was anticipated that the attained results would be of a more consistent nature.

A further strength of the study is that it holds the ability to supply current statistics in relation to the attacking strategies employed pre and post the 2009 self – pass rule introduction. Tromp and Holmes (2011) have conducted the only study considering the effect that the self – pass rule change has had upon the game of field hockey at an elite level and as such this study has enabled an understanding to develop as to how the rule has further embedded itself within the sport.

### **5.4 Limitations**

Despite the fact that this study has provided up to date, quantitative information with regards to the effect the self – pass rule has had upon attacking strategies, future research should consider the following.

The most pertinent limitation of this study is the issue surrounding the subjectivity of all occurrences within the world of performance analysis. Each and every observation coded was based on operator defined definitions which, supported by research conducted by O'Donoghue (2010), are subject to subjective judgement. This air of subjectivity has the ability to affect the overall influence that the findings of all studies have upon furthering research in their respective areas.

A more exclusive limitation that can be drawn from the current study is relatable to the sample of teams taken from each tournament. As both samples are generated using only a number of teams from each tournament, the ascertained data may not be fully representable of all teams in relation to the individual application of the self – pass rule. Each team is likely to have a slightly different style of play which will affect the application and implementation of the same rule change. This variation in application is most likely viewable when comparing northern and southern hemisphere attacking play styles. Many sports such as rugby have benefited from research surrounding the difference between northern and southern hemisphere in relation to patterns of play (Jones, Mellalieu, James & Moise, 2004; Stanhope & Hughes, 1997).

The vast quantity of self – pass data analysed throughout the study enables the findings to be generalised toward a larger hockey population. Despite this, the findings have come from an analysis that specifically focused on elite level women’s field hockey and as such may not represent any findings generated through a study based upon grassroots and amateur level field hockey.

## **5.5 Practical Implications**

The sole practical purpose of research is to initiate a meaningful change within a performance, be it on an individual or team level (Atkinson, 2003). The results of the current study are based upon elite standard level women’s field hockey teams, which enables the data to be applied by coaches and analysts working within that performance setting. The application of performance analysis can be seen as aiding this process as only 40% of successful plays can be recalled by coaches after the game (Franks & Miller, 1991).

Essentially patterns of play which result in a play restart method occurring within an attacking 25 yard area should be promoted, allowing attacking teams to be more effective. As most circle entries were made from the right hand side it is clear that attacking teams prefer to enter the circle from the right, as a result of most attacking self –passes being played on the right hand side of the pitch.

As the study consists of twelve games (n=12) certain teams will have been inadvertently omitted from the study, leading to the requirement of an objective analysis to allow an aggregate data sample to be extracted (Hughes & Bartlett, 2002), better representing all

teams within the acknowledged tournament. Fundamentally a larger sample size, incorporating a minimum of one analysed game per team will facilitate this expansive set of aggregate data.

Chapter VI  
Conclusion

## 6.1 Main Findings

The aim of this study was to enhance the understanding of the impact the self – pass rule change had in elite level women’s field hockey. Through the application of relevant procedures this has been accomplished and has also uncovered many interesting instances. As a direct result of these procedures, recent and up to date statistics have been produced in relation to the attacking strategies employed within two sample groups, one focused on today’s more contemporary sport of field hockey. The results ascertained from the study have enabled the acceptance of each proposed hypothesis, specifically the hypothesis that suggested more self passes will be performed within any attacking 25 yard area. Furthermore it is evident that the other hypotheses have been proved correct.

The results generated through this study indicate that there are differences in the employed attacking strategies, evident between the 2008 and 2012 data, thus supporting similar previous research (Tromp & Holmes, 2011). Through prohibiting the ball being played immediately into the circle from within the 25, it can be observed that a significant change in the way the circle is penetrated has been established by many teams.

The assessment of attacking strategies enabled the identification of differences between the two samples, leading to subsequent use and application of a Mann Whitney U Test, which helped reveal where exactly the significant differences exist. The most germane strength of this study was its capacity to further the base of research within the area, whilst bringing research up to date.

## 6.2 Future Recommendations

The results generated present a foundation upon which additional research can be conducted. Recommended areas for future research include:

- Conduct the same analysis with a larger sample size, allowing for a more in depth profile of performance to be generated (Hughes & Bell, 1998).
- Investigate the impact that the self – pass rule change has had upon all levels of hockey, ranging from grassroots to elite level, whilst also considering whether or not the rule is implemented differently between male and female hockey.
- Consider the impact of possession time, with specific reference to goal scoring, as has been focused upon in other team sports (Hook & Hughes, 2001).
- Explore the effect held by current game status on factors such as possession time and patterns of play (Redwood-Brown, 2008; Scully & O'Donoghue, 1999).
- Investigate the effect that the 2012 rule change which prevented the ball from being played straight into the circle until it has moved at least 5 yards may have had on attacking strategies.

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## Appendices

Appendix A  
Fixture and Results List

A. A list of the analysed fixtures and results from the Women's Champions Trophy 2008

1. China 2 vs. Argentina 1
2. Germany 2 vs. Australia 1
3. Netherlands 3 vs. China 1
4. Argentina 2 vs. Japan 1
5. Australia 1 vs. Argentina 2
6. Japan 1 vs. Germany 2

B. A list of the analysed fixtures and results from the Women's 2012 Olympic Games

**Pool A**

1. Netherlands 3 vs. Belgium 0
2. Great Britain 4 vs. Japan 0
3. Belgium 0 vs. Great Britain 3

**Pool B**

1. Germany 2 vs. United States 1
2. South Africa 1 vs. New Zealand 4
3. South Africa 0 vs. Germany 2

Appendix B  
Pilot Study Code Window and Results

## A. Pilot study code window

The screenshot shows the Studicode software interface. On the left, a video player displays a soccer match between Argentina and USA. The score is 0-1, and it's the 1st minute. The video player has a timeline at the bottom. On the right, the 'Code Window - Pilot Study & Reliability Study (35mins)' is open. It features a tactical diagram of a soccer field with various positions labeled: Attacking 25 Left, Attacking 25 Centre, Attacking 25 Right, Attacking Left (AL), Attacking Centre (AC), Attacking Right (AR), Defensive Left (DL), Defensive Centre (DC), Defensive Right (DR), Defensive 25 Left, Defensive 25 Centre, and Defensive 25 Right. A red vertical bar on the right side of the diagram is labeled 'Self Pass'. To the right of the diagram, there are labels for 'Goal', 'Shot Wide', 'Short Corner', and 'Shot on Goal'. Below these are color-coded boxes for 'Successful Pass', 'Pass Unsuccessful', 'Successful Dribble', and 'Dribble Unsuccessful'. The code window also has a menu bar with options like Capture, Code, Label, Edit, Matrix, Enter (TAB), Clear (ESC), Reset, Button, Keys, and Links.

## B. Results acquired from the Pilot Study

Linked to: Timeline - Pilot Study USE IN DISS

	Attacking 25 Left	Attacking 25 Right	Attacking Centre (AC)	Attacking Left (AL)	Attacking Right (AR)	Centre Circle (CC)	Defensive 25 Centre	Defensive 25 Left	Defensive 25 Right	Defensive Centre (DC)	Defensive Left (DL)	Defensive Right (DR)	Dribble Unsuccessful	Left Circle (LC)	Pass Unsuccessful	Self Pass	Short Corner	Successful Dribble	Successful Pass	
code 001	3	6	7	2	1	1	2	4	7	5	3	2	10	1	15	28	1	9	30	0
Free - Hit	3	6	7	2	1	1	2	4	7	5	3	2	10	1	15	28	1	9	30	42

Appendix C  
SPSS Output

Play Restart Phase Mann Whitney

1= 2008 2= 2012

**Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
SixteenYardHit	1572	1.08	2.518	0	29	.00	.00	1.00
LongCorner	1572	.80	2.260	0	22	.00	.00	1.00
SideLine	1572	3.88	6.992	0	64	.00	1.00	5.00
FreeHit	1572	5.03	8.384	0	70	.00	2.00	6.00
PreorPost1	1572	1.47	.499	1	2	1.00	1.00	2.00

**Ranks**

	PreorPost1	N	Mean Rank	Sum of Ranks
SixteenYardHit	1	840	748.87	629053.50
	2	732	829.68	607324.50
	Total	1572		
LongCorner	1	840	744.80	625634.50
	2	732	834.35	610743.50
	Total	1572		
SideLine	1	840	705.98	593025.50
	2	732	878.90	643352.50
	Total	1572		
FreeHit	1	840	710.21	596574.50
	2	732	874.05	639803.50
	Total	1572		

**Test Statistics<sup>a</sup>**

	SixteenYardHit	LongCorner	SideLine	FreeHit
Mann-Whitney U	275833.500	272414.500	239805.500	243354.500
Wilcoxon W	629053.500	625634.500	593025.500	596574.500
Z	-4.187	-5.095	-7.820	-7.280
Asymp. Sig. (2-tailed)	.000	.000	.000	.000

a. Grouping Variable: PreorPost1

## Zone Classification Mann Whitney

### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
ZoneUpgrade	52	15.85	12.885	0	41	5.00	14.00	26.00
ZoneDowngrade	52	6.85	6.596	0	22	1.00	4.00	12.75
PreorPost1	52	1.46	.503	1	2	1.00	1.00	2.00

1=2008 2=2012

### Ranks

	PreorPost1	N	Mean Rank	Sum of Ranks
ZoneUpgrade	1	28	27.48	769.50
	2	24	25.35	608.50
	Total	52		
ZoneDowngrade	1	28	27.46	769.00
	2	24	25.38	609.00
	Total	52		

### Test Statistics<sup>a</sup>

	ZoneUpgrade	ZoneDowngrade
Mann-Whitney U	308.500	309.000
Wilcoxon W	608.500	609.000
Z	-.506	-.498
Asymp. Sig. (2-tailed)	.613	.618

a. Grouping Variable: PreorPost1

Appendix D  
Ethical Approval

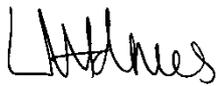
Date: 11 March 2014

To: Christopher Jefferies (st200006564)

Project reference number: 13/05/176U

Your project was recommended for approval by myself as supervisor and formally approved at the Cardiff School of Sport Research Ethics Committee meeting of 29th May 2013

Yours sincerely

A handwritten signature in black ink, appearing to read 'L. Adams', written in a cursive style.

Supervisor