WARM-UP PROVISION IN FIELD HOCKEY: A COMPARISON BETWEEN LITERATURE AND PRACTICE

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ABSTRACT

When looking at literature it is evident that there is a shortage of research focused on the warm-up in field hockey. After the warm-up the athlete should have an increased mental focus, increased body and muscle temperature and be ready for the task specific activities he is about to take part in (Cone, 2007). The present study compares the literature in the area and tries to compile an image of the best way of improving a warm-up.

Thirteen teams on National League and Premier Division level agreed to participate in this study. All teams were observed using a newly developed observational instrument, designed to observe hockey warm-ups. Subsequently, coaches were interviewed using a semi-structured interview protocol to investigate their background in the area and to get a good view of the choices they made in warm-up design.

The findings of the study conclude that there are a large number of factors a coach has to take into account when designing a warm-up, such as duration, warm-up phases and stretching. Finally, the researcher will finish off by giving guidelines for a warm-up in field hockey, constructed from previous research in the area, observations in practice and interviews with the coaches involved.

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CHAPTER 1: INTRODUCTION

1.1 Introduction to the chapter

This chapter will provide an overview of the structure of this thesis as a whole. It will introduce the purpose of the study (research question) and some of the background that already exists in the specific area. Throughout this thesis, the researcher may at times use masculine pronouns (such as he, him and his) when referring to coaches or players in this study. This is purely for ease of reading and is not intended to indicate any bias against female coaches or players whatsoever.

1.2 Background of the study

The warm-up should prepare an athlete for the demands of exercise (Woods, 2007). After the warm-up the athlete should have an increased mental focus, increased body and muscle temperature and be ready for the task specific activities he is about to take place in (Cone, 2007). Through the improvement of their warm-up activities it is possible that participating teams acting upon the findings of the present study could benefit from a better team performance. However, the current research literature suggests that there has been very little research focused on the warm-up activities employed in the sport of field hockey. Yes, there has been a lot of research on warm-up activities in many other sports (Young and Behm, 2002; Bishop, 2003a; 2003b; Young, 2007; Fradkin et al, 2010), but in fact, the present study is the first piece of research to investigate this specific area within the sport of field hockey and could therefore stimulate future research. Sport at high level is a profession in which a small edge can make a difference. If warm-up could be improved a team could highly benefit from this during competition.

1.3 Introduction to the Research Goal

Since there has not been a lot of research on warm-up activities within the sport of field hockey, there is need for a set of guidelines coaches can use when designing the warm-up for their team. Therefore the research goals of this study are:

1. To compare the literature in warm-ups in other sports to what is observed in practice within the sport of field hockey.
2. To find out how research findings in warm-ups in other sports can be used in the sport of field hockey.
3. To create an overview of all the factors that impact the design of the warm-up and create a set of guidelines which will help coaches design the perfect warm-up for their athletes.

Information that will be used to reach the research goal consists of:

- Previous research in multiple other sports and then translating this to field hockey.
- Observations of warm-ups in field hockey on Premier Division and National League level in the UK.
- Interviews with head coaches or warm-up leaders of participating teams to compile an image of their background knowledge and the choices they made in warm-up design.

1.4 Methodological background

Most previous research in the sport of field hockey was done on physiological capacities of players and ideal ways of training elite athletes (Starkes, 1987; Reilly and Borrie, 1992; Boyle et al, 1994; Elferink-Gemser M., 2004; 2006; Durandt et al, 2007). Methods used in these studies were most commonly based on athletes performing a pre-designed exercise protocol to test their abilities in certain areas such as endurance.

Further, research in field hockey has been done on a Time Motion Analysis (TMA) basis. TMA is an effective way of quantifying the specific physical demands of a certain sport (Deutsch et al, 2002). When the physical demands are clear, coaches and athletes can prepare themselves in the best possible way for the workload that is to come. In field hockey, this has been done by Boyle et al (1994), Spencer et al (2004; 2005) and MacLeod et al (2007). They all used observations to establish the activity profile of elite field hockey players during competition.

To get a better look at the way coaches learn and the choices they make in warm-up design, semi-structured interviews were conducted with the participating coaches. This research method has previously been used (Salmela, 1995; Jones et al, 2003) to analyze coach learning styles. By combining both qualitative (interviews) and quantitative (observations) methods, a mixed methods approach was created. More about this topic can be found in the methodology chapter (chapter 3).

1.5 Thesis structure

Following on this introductory chapter, chapter 2 will explore most of the research that has been done in the area of warm-up in different sports. A translation will be made to field hockey, since very little has been written about pre exercise routines in this sport. Chapter 3 will look at the methods used in previous research, as well as in the present study. The methodology will be outlined and the research instruments for observation and interviews will be presented. Chapter 4 will provide a discussion of the results of the study, after which conclusions will be drawn in chapter 5. This final chapter will also highlight any possible directions for future research in this field.

1.6 Chapter conclusion

This chapter has outlined the motive for the present study. Therefore the goal of this study is to compare the literature in warm-ups in other sports to what is observed in practice within the sport of field hockey. The second research goal is to create an overview of all the factors that impact the design of the warm-up and create a set of guidelines which will help coaches design the perfect warm-up for their athletes.. This will be realized by using observations in practice and by conducting interviews with participating coaches. The following chapter will investigate the research that has previously been conducted in the area.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction to the chapter

The goal of this literature review is to take a look at key references in the area of warm-up in multiple sports and to critically evaluate what has been studied within this area. This chapter will focus mostly on active warm-up prior to exercise and performance, although it will touch on passive warm-up techniques briefly (Bishop, 2003a). The chapter will start of by giving a definition of warm-up, followed by a summary of all the components of the warm-up and their pros and cons. Following this broad review of warm-up in sports, a translation of the information will be made to the sport of field hockey. Finally, a summary will be given in which the researcher will attempt to form an image of an ideal warm-up in this sport, as it is outlined by previous research.

2.2 The sport of field hockey

Field hockey is a fast-paced game which nowadays (2010) is only played on artificial turf. The game is played with 11 aside (with a maximum of 5 extra players who can be substituted) on a 91m by 55m pitch. The rules of the game allow unlimited substitutions. Unique to field hockey is the semi-crouched position in which players move a large percentage of the match or training session. This causes extra physiological strain on players (Reilly and Seaton, 1990). During matches a player is faced with a lot of short high energy sprints, alternated with short periods of relatively low intensity activities. The intermittent nature of the game and the large number of changes in direction makes repeated sprint ability an important skill for field hockey players (Elferink-Gemser et al, 2004). This is emphasized even more with the newly introduced rule which allows a player to pass a free hit to himself to quickly resume play at any time when certain conditions are met (Rules of hockey, 2009).

2.3 Warm-up definition and goals

A warm-up can be defined as a pre-exercise routine that has two goals (Woods et al, 2007):

- Improving muscle dynamics to reduce the risk of injury.
- Preparing the athlete for the demands of exercise.

Combined, these goals are targeted to increase an athlete's performance during a training session or competition and to minimize the risk of injury (Shellock and Prentice, 1985). In general, the warm-up should produce a mild sweat without fatiguing the athlete (Woods et al, 2007).

The role of the warm-up in injury prevention has lately been researched a lot. Soligard et al (2008) carried out a randomized controlled trial on young female footballers. They designed a comprehensive warm-up program to improve strength, awareness and neuromuscular control during static and dynamic movements. There test group showed a lower risk in severe injuries, overuse injuries and overall injuries, compared to the control group.

Woods and colleagues (2007) have reviewed a number of studies and also came to the conclusion that consistent use of warm-up and stretching routines prior to physical activity should benefit the athlete in increasing flexibility and range of motion. This could "potentially" lead to less musculotendinous injury. It has to be mentioned that this is a very soft conclusion of a very detailed report. In 2007, Malliou and colleagues looked at the incidence of injuries in dance aerobics instructors. They found that the duration of the warm-up had a significant effect on the number of injuries. The results showed however that static stretches that were included in the warm-up, did not relate to the number of injuries. Overall it can be noted that warm-ups do seem to decrease the chance of injury during subsequent

activity, while stretching does not seem to have any positive effect on this matter. Stretching will further be discussed in chapter 2.4.2. More research needs to be carried out to further define the role of a good warm-up in injury prevention.

After the warm-up an athlete should have an increased mental focus, increased body and muscle temperature and should be ready for the task-specific activities that he is about to take place in (Cone, 2007). Fradkin et al (2010) carried out a systematic review of all research projects in the field of warm-up from 1958 till 2008 that included humans and warm-up activities other than merely stretching. They reviewed 32 studies in total and found that warm-up improved performance in 79% of the studies they examined. In 17% of the studies a decrease in performance was noticed. Fradkin et al (2010) found that the warm-up protocols in these studies were very unlikely to affect the performance. The protocols used in these studies where either not sport-specific or on a low intensity and therefore it can be concluded that there is little evidence to suggest that warm-ups before strenuous activity might affect performance in a negative way. Overall, the literature in the area shows the importance of a good warm-up before performing in any vigorous activity. Multiple studies have shown the importance of a good warm-up in injury prevention and preparation for physical activity.

2.4 Warm-up design

The design of a warm-up is an important area to understand for both researchers and coaches to ensure that athletes are prepared in the best possible way for the activities that are to come. There are two different forms of warm-up: passive warm-up and active warm-up. In a passive warm-up the core-temperature of the athlete is raised by external influences, i.e. saunas, heating vests with warm elements inside or hot showers (Bishop, 2003a). Even though this form of warm-up raises the core and muscle temperature, it is likely that an active warm-up induces greater internal changes in cardiovascular and metabolic systems (Bishop, 2003a).

Passive warm-up could be used when there is an unplanned delay between the warm-up and the performance itself or if the weather is cold which might cause the body's core temperature to drop again in a short period of time. The focus of this study however, will be on active warm-up techniques.

The design of the active warm-up may include a number of different components. When looking at the literature in the field, three components are most commonly named and used:

1. A general or sport specific sub-maximal component:

   Such as jogging or cycling. This form of activity will increase the body and muscle temperature and elevate oxygen consumption (Bishop, 2003a).

2. A stretching component:

   A. Static stretching: Can be defined as slow or passive stretching (Kreighbaum and Barthels, 1996). Different protocols for static stretching are used with i.e. different stretching times, different numbers of sessions and different intensities.

   B. PNF: Another form of stretching is Proprioceptive Neuromuscular Facilitation (PNF) stretching. This technique makes use of proprioceptive stimulation for the strengthening or relaxation of particular muscle groups (Ferber et al, 2002).

   C. Dynamic stretching: Involves the use of bouncing or jerking type motions to stretch a muscle group (Amako et al, 2003).

3. Rehearsal of the skill that is about to be performed (Young and Behm, 2002):

   The intensity of the skills that are about to be executed in game will generally increase during the warm-up. This will prepare the body for the physical exercise that is to come, through the activation of the specific muscle fibers

and neural pathways involved in the activity. This component is also known as the sport-specific phase.

As Bishop (2003a) mentions in his review that there are many factors that influence the structure of the warm-up (e.g. task to be undertaken, physical capabilities of the athlete and the environmental issues, such as temperature and humidity). A key factor is the necessity to tailor warm-ups to individuals (which is also mentioned by; Woods, 2007), which may differ from player to player in any given team. Perhaps this could even depend on position in the squad or physiological capabilities. In the upcoming paragraphs a clear outline of the importance of the different components of the warm-up will be given.

2.4.1 General sub-maximal component

A warm-up usually starts with a sub-maximal component. The sub-maximal component targets to increase the body's core and muscle temperatures (Bishop, 2003a). An elevation in muscle temperature causes a number of reactions in the body: it has a positive influence on the activity of enzymes, which catalyzes chemical reactions in multiple energy systems (Martin et al, 1975), it will increase muscle blood flow (Barnard et al, 1973), it will increase in the speed of nervous impulses (Shellock and Prentice, 1985) and oxygen will be more readily released from red blood cells and transported to mitochondria (Van de Graaff and Fox, 1999). It is extremely important that the core body temperature does not get to high (Duffield et al, 2003). This can be a problem when an athlete participates in strenuous activity in warm or humid conditions. If the core body temperature gets too high the athlete's performance will be impaired (Nielsen, 1996), because the chemical reactions in the body will slow down again.

Bishop (2003a) concludes in his review of active warm-up protocols that it is likely that an active warm-up increases long-term (> 5 minutes) performance by elevating the baseline VO_2 (oxygen consumption) before exercise. Research in the area of warm-up and the effect on long-term performance in the sports of running, kayaking and cycling has shown that a warm-up increases long-term performance (Grodjinovsky and Magel, 1970; Bishop, 2003b; Atkinson et al, 2005). Research methods and results of a number of these studies will further be discussed in the upcoming paragraphs.

Grodjinovsky and Magel (1970) looked at 1-mile times of athletes after a more intensive warm-up (5 minute jogging) that also contained a 161m sprint. After this warm-up the athletes showed improvements on the 1-mile run compared to the control group. A reason for this improvement could be that more neural patterns get activated during short intense activities. Bishop (2003b) reports that athletes performed better in kayaking after a warm-up that contained some sprints with recovery, comparing them to a control group that did a normal warm-up without the sprints. This could be explained via an increase in neuromuscular activation and a higher elevation in VO_2, due to the sprints. Atkinson et al (2005) have looked at time trials in male cyclists. The subjects in this study participated in the same time trial twice: once without a warm-up and once with a 25 minute warm-up at 60% of their peak power. The results showed that warm-up generally improved performance, since the athletes were faster when they performed a warm-up.

A number of the other studies that Bishop (2003a) examined did not report an increase in performance (Andzel et al 1976; 1978; 1982). This is likely to be because the warm-up protocols in these studies were of a very low intensity and therefore unlikely to have affected the VO_2. These three studies were all aiming to increase endurance performance in which VO_2 is an important component. By not increasing the baseline VO_2 it is unlikely that a positive effect on endurance performance will be demonstrated.

Some other studies in Bishop's review (2003a) showed that warm-up may impair long-term performance. Gregson (2002) has looked at active warm-up in healthy soccer players. He found that the group that did an active warm-up (70% of VO_2max, until a rectal temperature of 38ºC was reached) could do less 30s bouts of high intensity treadmill running (90% of VO_2max) than a control group. Because his sample consisted of only 2 males per group, one can wonder if his findings are significant. This study was executed in moderately warm and humid conditions, which may also have impaired performance. Bishop (2003a) did state in his review that (p.490) 'a comparison of the results [*of all different warm-up protocols*] was made difficult by the use of different warm-up routines, different performance tasks and different performance times'. This might be an important point for future research.

2.4.2 Stretching component

Static stretching

Static stretching can be defined as slow or passive stretching (Kreighbaum and Barthels, 1996). When analyzing individual performance sports, different forms and effects of stretching during the warm-up have received a considerable amount of research. Young (2007) has written a review article on the effects of static stretching. His commentary (p. 212) 'discusses many of the methodological issues that can influence conclusions about the acute effects of static stretching on performance'. He has looked at approximately 15 studies in different sports (e.g. sprinting, high-jump, soccer and dancing) and concluded that most of the literature shows that static stretching during the warm-up has a negative effect on performance in sport. This is because static stretching will cause a decrease in muscle strength (Evetovich et al, 2003), muscle power (Marek et al, 2005) and muscle strength endurance (Nelson et al, 2005). The important point in Young's review (2007) is that coaches should balance the negative effect of stretching on performance with the fact that it might help to

prevent injuries in a later stage. Therefore it might be a better concept to use static stretching in the cool-down phase, after strenuous activity. Young (2007) specifically advises sports researchers to design a sport specific warm-up with an optimal balance between components of sub-maximal intensity exercise, stretching and sport-specific activities that prepare the athlete for the practice session or competition that he will participate in.

PNF Stretching

This stretching technique makes use of proprioceptive stimulation for the strengthening or relaxation of particular muscle groups (Ferber et al, 2002). Marek et al (2005) studied the acute effects of PNF (Proprioceptive Neuromuscular Facilitation) stretching on muscle strength and power output on 19 athletes who were healthy and recreationally active in multiple different sports (engaging in sport for 1 to 5 hours per week). The subjects carried out a warm-up and after the warm-up their range of motion (ROM) and isokinetic capabilities where measured. Isokinetic capabilities contained the peak torque of the extension of the dominant leg and mean power output. After these measurements, they had to carry out a PNF stretching protocol, or a static stretching protocol, after which their ROM and isokinetic capabilities where measured again. All subjects had to complete the whole routine with both stretching protocols, in random order.

The results showed that PNF stretching caused a deficit in strength, power output and muscle activation. The static stretching protocol also caused a decrease in performance over the isokinetic tests. Both protocols however, showed a slight improvement in ROM.

Another study by Church et al (2001) looked into PNF stretching as part of a general warm-up in vertical jump performance. Subjects were 40 females who were subjected to three different warm-up protocols (general warm-up, general warm-up and static stretches, general warm-up and PNF stretches) over three nonconsecutive days. The results showed a decrease

in vertical jump performance for the PNF treatment group. These studies show that the use PNF stretches will decrease performance and should therefore not be included in the warm-up.

Dynamic stretching

Dynamic stretching involves the use of bouncing or jerking type motions to stretch a muscle group (Amako et al, 2003). Little and Williams (2006) carried out a study to test dynamic stretching in the warm-up for professional soccer players. They tested 18 professional players on a number of skills that are important in soccer. This crossover study looked at three different warm-ups. The condition that used dynamic stretching scored best on most of the tests (i.e. 10-m sprint, 20-m flying sprint and agility performance) and scored the same as the other groups on the other test (vertical jump). They concluded that dynamic stretching can improve performance, when executed during the warm-up. Curry et al (2009) have looked at different forms of stretching in untrained females. They tested 24 healthy females, who all did 5 minutes of light aerobic activity followed by one of the three warm-up pre designed stretching protocols (static stretching, dynamic stretching or light aerobic activity). After the warm-up, the subjects executed the following tests: modified Thomas test, countermovement jump, and isometric time to peak force knee extension. The researchers didn't find any significant differences between the scores of the three warm-up groups, although data suggested that dynamic stretching had a better effect on performance than static stretching, when looking at the power component in the tests.

McMillian et al (2006) also carried out research on dynamic stretching. They compared a group that executed a dynamic warm-up (DWU) to a control group that did no warm-up at all (NWU) and third group that did a warm-up containing static stretches (SWU). They found significantly better scores ($p < 0.01$) on all three performance tests (T-shuttle run, underhand

medicine ball throw for distance, and 5-step jump) in the DWU group. They did not find any significant differences between the SWU and the NWU groups. In another study, Yamaguchi and Ishii (2005) also compared a static stretching group, dynamic stretching group and a control group, when looking at leg extension power. They concluded that leg extension power after dynamic stretching was significantly greater ($p < 0,01$) than the leg extension power in the control group. They found no significant difference between the static stretching group and the control group. This was also suggested by Fletcher and Jones (2004) who carried out a study in rugby union players who had jog for 10 minutes, followed by two 20 meter sprints. After these sprint the subjects participated in a dynamic stretching protocol, followed by another two 20 meter sprints. This study showed that sprint performance significantly ($p \leq 0,05$) improved after using a dynamic stretching protocol, when compared to a control group. Once again, this study also showed that static stretching had a detrimental effect on sprint performance.

When looking at these different studies, the evidence from previous research shows that dynamic stretching has a positive effect on performance when looking at speed, agility and power. Static stretching and PNF stretching do certainly not improve performance when performed during the warm-up and are likely to result in a performance decrease.

2.4.3 Skill rehearsal

The final phase of the warm-up consists of pre game skill rehearsal. By carrying out a sport specific element during the warm-up the body will prepare itself for the physical exercise that is to come, through the activation of the specific muscle fibers and neural pathways involved in the activity (Young and Behm, 2002). Very little research has been conducted on the effects of a sport specific component in the warm-up to prepare an athlete for the task at hand. It has been suggested that performance may be improved via an increase

in neuromuscular activation in the muscles that are needed for the actual performance (Bishop, 2003a). Important to take into consideration, is the fact that the exercises containing the skill rehearsal should be brief, to make sure that the athlete does not get fatigued before the start of the performance.

2.5 Warm-up intensity and duration

An intensity of around 70% of the VO_2max seems to be ideal for the intermediate performance (Stewart and Sleivert, 1998). In this study, the researchers describe intermediate performance as an activity which lasts between 10 seconds and 5 minutes. Assumptions can be made that a similar intensity will be optimal for performances, which last longer than 5 minutes. Important, is that this might mean that not all the athletes in a team should do the same warm-up, since every single athlete has a different VO_2max and taking into consideration the fact that some might need more recovery time than others. This theme also emerged in chapter 2.4.

The intensity of the warm-up should not fatigue the athlete. Franks (1983) describes that a value of 60-80% of VO_2max may be needed to elevate the core body temperature in highly conditioned athletes. Franks (1983), as well as many others (Genovely and Stamford, 1981; Stewart and Sleivert, 1998), states that it is better to stay below the lactate threshold at all times, since lactate production will impair performance and recovery after strenuous activity.

When looking at warm-up duration, Franks (1983) has found that VO_2 reaches a steady state within 5 to 10 minutes. They used a warm-up protocol where subjects did a warm-up on 60-80% of their VO_2max. This was later confirmed by Özyener et al (2001). In this study the six male subjects were instructed by Özyener and colleagues to take part in exercise tests of 5 different levels (low, medium, high, very high and severe) on different days. Subjects' VO_2max reached a steady state after about 10 minutes in the low, medium and high

intensities. On the 'very high' and 'severe' level no VO_2max plateau was reached. From this information it can be suggested that a warm-up should at least take 10 minutes on a moderate to high intensity in order to get the VO_2 at a steady state.

Franks also mentions in his research article that the warm-up activity should last between 5 and 20 minutes. If the warm-up duration of the warm-up activities is too long, this may result in muscle glycogen depletion (Gollnick et al, 1973). No studies have been found that describe the duration of a complete warm-up in team sports or give a definition of the duration of the sport specific segment of the warm-up.

2.6 Warm-up decrement

Warm-up decrement can be described as 'the gradual loss of the effects of warm-up during a period of inactivity between the warm-up and competition. A warm-up decrement may occur after only a few minutes of inactivity' (Adams, 1961). Adams also mentions the Franks (1983) states that the less time elapsing between the warm-up and the performance, the better it is for the athlete. If there is too much time between the warm-up and the actual performance, VO_2 will drop back to its baseline value and the body temperature will drop, which takes away the positive effect of the warm-up. To prevent the body and muscle temperature from dropping, passive warm-up techniques can be used.

Another thing that could happen is an athlete losing his mental focus. To prevent the athlete from losing the mental focus, different techniques can be used.

2.7 Psychological factors influencing the warm-up

This paragraph will deal with the different psychological benefits that can naturally result from an effective warm-up. As mentioned earlier, athletes should have an increased mental focus after the warm-up (Cone, 2007). Sport psychology deals with concepts like mental

focus, arousal, anxiety and attentional focus. Arousal is defined as a state of alertness and readiness which prepares the body for performance (Patel et al, 2010). Moderate levels of arousal are associated with an increase in performance (Gould and Krane, 1992). However, excessive arousal levels lead to anxiety. Anxiety is defined as an emotional reaction to a stimulus perceived as dangerous (Spielberger, 1972). Research has shown that excessive anxiety will decrease attentional functioning in sports (Janelle, 2002) and therefore is the cause much of the variance in performance in sports (Davis and Sime, 2005). Research has shown that a warm-up can decrease levels of anxiety during competition (Gould et al, 2008). Therefore a warm-up will naturally cause an increase in performance.

Self-efficacy is defined as one's expectation to successfully perform a specific behavior or action required to produce a certain outcome (Bandura, 1977). High self-efficacy is important for successful performance (Bandura, 1997). A successful warm-up can increase self-confidence (Keating et al, 2003). Keating and colleagues showed that self-efficacy increased as a result of a 10 minute warm-up in cycling. An addition, previous research has shown that team performance is closely related to self confidence (Feltz, 1988). Feltz even states that confidence in ones team to do well is just as important as self confidence. Therefore, a warm-up can naturally increase performance through psychological benefits.

2.8 Warm-up in field hockey

Because of the evident shortage in research in the field of warm-up in field hockey, information has been gathered from a variety of sports. One of the sports that is quite similar to hockey on a physiological basis is football (soccer), the most popular team sport in the world. Multiple studies have shown that field hockey is physiologically comparable to soccer. 'They have both been described as multiple sprint sports consisting of high-intensity sprints that require short bursts of near maximal effort lasting between 5 and 10 seconds' (Lakomy

and Haydon, 2004; Mayhew and Wenger, 1985; Tumilty, 1993), as quoted from Durandt et al (2007, p. 74). So to get a better look at a sport-specific warm-up, it could be possible to look at soccer warm-ups. However, even in soccer there is a shortage on research in the field of warm-up design. There are only a few studies that have looked at stretching components in a warm-up and none that have looked into the sport specific phase of the warm-up. This shows that there is a clear gap in the literature in warm-up research, not only in the sport of field hockey but even in sports as popular and broadly played as soccer. Studies that have looked into field hockey are either on the subject of Time Motion Analysis (Reilly, 1990), talent identification in youth (Elferink-Gemser et al, 2004) or development of physiological capabilities (Elferink-Gemser et al, 2006). The next chapter will show the different research methods that have been used so far in the area of warm-up in sports.

2.9 Research methods in warm-up research

A lot of the research in the area of warm-up in sport (e.g. Ferber et al, 2002; Gregson et al, 2002; Behm et al, 2004; Marek et al (2005); Faigenbaum et al, 2006; Wittekind and Beneke, 2009) is focused on different warm-up interventions and their impact on performance. In these studies, the subjects are instructed to use a variety of warm-up protocols. After the warm-up, performance is measured in different ways (e.g. reaction time, lactate levels or run time to exhaustion). In other studies the subjects are allowed to execute their own warm-up (Mandengue et al, 2005). Following the warm-up, performance was then measured to determine the effects of these different warm-up protocols. In all the studies that look into warm-up, performance measures have been used to rate the level of success of each warm-up intervention.

To improve performance in sport, coaches and athletes should apply research findings when designing a warm-up. Studies have looked at whether knowledge from research is being

translated to actual sporting practice. One of these studies was by Twomey et al (2009). They reviewed the knowledge coaches had in the area of delivering training programs according to the latest scientific evidence in the area, which in this case was Australian Rules Football. They handed out semi-structured questionnaires to assess coaches' knowledge on delivering training programs and validated their answers by looking at training sessions that they delivered. The researchers concluded that (p. 452) 'current football training sessions do not give adequate attention to the development of skills most likely to reduce the risk of lower limb injury in players' (Twomey et al, 2009). Another of their research findings was that only one of the nine teams that participated had a structured warm-up. Twomey et al (2009) furthermore showed that coaches do accumulate knowledge from research, but do not implement this is their training sessions on the pitch. Balance was rated as one of the most important aspects of lower limb injury prevention, but was only used by one of the coaches and even that coach gave it minimal attention. They also concluded that there is a need to improve the transfer of knowledge from research to practice. Research by Mallonee et al (2006) and Brussoni et al (2006) also show this gap between research and the implementation of its results into practice.

One of the few studies that have looked into closing this gap is the study by Finch (2006). She came up with the TRIPP framework (Translating Research into Injury Prevention Practice). The key goal of the framework is to make sure that research gets implemented into practice. Researchers should make this easy for coaches by including information on how to implement the findings of their study into real world training sessions. Since there are only few studies looking at whether knowledge is implemented from research into practice, this will be one of the key areas in this study will be seeking to answer.

2.10 Summary and Suggestion of the ideal warm-up in field hockey

When composing an ideal warm-up in field hockey all the information above needs to be 'translated' to hockey. As mentioned before in this literature review, Young (2007) specifically advises researchers to design a sport specific warm-up with an optimal balance between a component of sub-maximal intensity, stretching and sport-specific moves that prepare the athlete for the practice session or competition that he or she will take place in.

When combining all the previous research literature into an ideal warm-up for field hockey players, this warm-up should have the following characteristics:

1. The duration of the submaximal, non-hockey specific component of the warm-up should be somewhere between 5 and 20 minutes. This is enough time to get the baseline VO_2 elevated and increase the muscle temperature, which makes the athlete ready for the activities he is about to take place in. There are no research articles that present an ideal duration for the warm-up as a whole, therefore there is no clear view on the exact duration of the stick and ball part of the warm-up. The present study will likely provide more insight in this matter.
2. The intensity should be around 70-80% of the VO_2max. The exact value depends on the physical condition the athlete is in; the better his physical condition, the higher the percentage of the VO_2max should be. Note that it is very important to stay below the anaerobic threshold to prevent lactate production, which will impair performance.
3. The warm-up components that should be included are:
    a. A sub-maximal component.
    b. A series of dynamic stretches. From the three forms of stretching (static stretching, dynamic stretching and PNF) available, dynamic stretching is the best to implement into the warm-up. Because field hockey players move in a semi-crouched position during the match or training session, it is important to

thoroughly stretch the lower limbs to build tension in the muscle. By developing sport specific stretches, the athlete can prepare himself in the best possible way for the training session or competition he is about to take place in.

c. A sport-specific component (skill rehearsal). This part functions as a stimulus for the neural pathways.

4. Components that should not be included in the warm-up are:
    a. Static stretches and PNF stretches. Research shows that these two forms of stretching will impair performance and therefore will take away the positive effect of the warm-up.
    b. Exercises that will cause the body to produce lactate (e.g. above the lactate threshold).
5. The warm-up should be well timed. The warm-up should finish just before the actual performance starts, to minimize warm-up decrement. If there are any complications concerning the start of the match, passive warm-up techniques can be used to prevent loss of body and muscle temperature and relevant imagery can be used to keep the focus of the athlete on the performance.

2.11 Chapter conclusion

This chapter gave the background information about the sport of hockey and showed the gap in literature that exists in this area. The chapter reviewed previous research in the area of warm-up in other sports and showed how this information can be used when designing a warm-up in field hockey. Observations in practice and interviews with coaches will be compared to this overview from literature to reach the research goals. The next chapter will introduce the methodology that will be used in the present study.

CHAPTER 3: METHODOLOGY

3.1 Introduction to the chapter

The purpose of this chapter is to introduce the methodology that is used in conducting the present study around the previously mentioned research questions:

1. To compare the literature in warm-ups in other sports to what is observed in practice within the sport of field hockey.
2. To find out how research findings in warm-ups in other sports can be used in the sport of field hockey.
3. To create an overview of all the factors that impact the design of the warm-up and create a set of guidelines which will help coaches design the perfect warm-up for their athletes.

Methodologies used by previous studies in the area will be reviewed and criticized before the research methods of the present study are detailed. The researcher and the participants will then be described. Ethical considerations will also be discussed when appropriate. Finally, the warm-up framework that will be used in data analysis will be presented.

3.2 Previous research in the area

As highlighted in the literature review, a lot of research in warm-ups has been focused around the effects of the warm-up on performance. This paragraph will consider the vast majority of methods in previous research in the area of warm-ups in different sports. A number of different methodologies in observational research and interview-based studies will be reviewed and criticized.

3.2.1 Methodology in observational research

The best way to look at implementation of research evidence into coaching practice is by observing the teams' behavior during the training session or in this case the warm-up. A lot of coaching research is based on observational techniques. There are different types of observational data collection techniques in research (Flick, 1998):

1. Direct (reactive) observation versus unobtrusive observation

   Direct observation is also known as overt observation. In this type of observation, the subjects are informed that they will be observed. One of the downsides of this is that they may react to the presence of the researcher and not behave in the way that would be natural to them.

   Unobtrusive observation is also known as covert observation. Opposed to overt operation, the subjects do not know they are being watched in this type of observations. A question that rises from this research is whether is ethical to observe someone without their consent, especially when dealing with minors or the more vulnerable groups of society (Federal register, 1991).

2. Non-participant versus participant observation

   These two are being used to clarify how much the researcher is actually a part of the community, group or team he observes. Non-participant observation is being defined by Adler and Adler (1994) as 'observers follow the flow of events. Behaviour and interaction continue as they would without the presence of a researcher, interrupted by intrusion' (p. 378). In non-participant observations the researchers maintains a distance between him and the subjects, to not change the events that take place in any way.

   A participant observation is being defined by Denzin (1989) as 'a field strategy that simultaneously combines document analysis, interviewing or respondents and

informants, direct participation and observation, and introspection.' (pp. 17-18). One of the benefits of this type of observation is that the researcher is a part of the group and if executed correctly will have no influence on the actions of the subject; therefore there will be no observer effect. Depending on the scale of participation in the field the actions of the subject may be influenced, for instance if the researcher gives someone advice or decides not to take place in certain rituals or celebrations.

3. Systematic versus unsystematic observations.

   Darst et al (1983) wrote about systematic observations as observations in which a trained person follows stated guidelines to observe interactions with the assurance that others viewing the same events would agree with the original researcher. Because of the stated guidelines, there will be less of a researcher bias involved in the observations.

4. Observation in natural versus artificial situations.

   This is all about the location of the observations. If they are made in the setting where you would normally expect the behavior to take place, it is a natural situation. This is the most common form of observation (Cohen et al, 2007) If the setting is a laboratory, this is an artificial situation. The advantage of an artificial setting is the great control researchers have over the circumstances, but the negative side of this is that behavior of individuals may change when the settings changes and the situation is unrealistic to the real world.

5. Self-observation versus observing others.

   Most of the research that uses observation to collect data is on observing other people. This is one of the areas where researcher bias is inevitable. The researcher always has a certain background which may influence the way he looks at the subjects of his research and the way he thinks about certain actions. It is therefore important for the

researchers to be reflexive and show the reader what background he comes from (Flick, 1998).

3.2.2 Reliability and validity in observational research

Reliability can be defined as: ‘The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.’ (Joppe, 2000, as quoted in Golafshani (2003)). Validity in qualitative research can be summarized as ‘a questions of whether the researcher sees what he or she thinks he or she sees’ (Kirk and Miller, 1986, p.21). Later, this definition was improved by Joppe (2000), as quoted in Golafshani (2003): ‘Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull’s eye" of your research object? (The Qualitative report, 2003, p. 599).

When looking at reliability and validity within qualitative research, it’s important that the result is replicable and that the measures really measure what the research is aiming for. If the results from a qualitative study are not valid and replicable, than predictions based on these studies cannot be relied on (Maxwell, n.d.). Depending on the exact size of the sample, care should be taken when generalizing findings. The smaller the sample, the less accurate the findings can be generalized. Also, where situations in both the study population and the real population appear to be similar, sub-surface differences between the two could make research findings obtained in one study, inapplicable in another one (Gassie, 1968).

3.2.3 Observational research in sport

An observational research technique that is commonly used in sport is time motion analysis (TMA). TMA is an effective way of quantifying the specific physical demands of a certain sport (Deutsch et al, 2002). When the physical demands are clear, coaches and athletes can prepare themselves in the best possible way for the workload that is to come. Observation has been used as a tool in the TMA of a lot of different sports. Some examples are cricket (Rudkin and O'Donoghue, 2007), field hockey (Boyle et al, 1994; Spencer et al, 2004; 2005; MacLeod et al, 2007), basketball (McInnes, 1995; Matthew and Delextrat, 2009) and soccer (Reilly, 1976; Mayhem and Wenger, 1985; Bangsbo et al, 1991; Bloomfield et al, 2007). Other examples can be found in Table 1.

Throughout the years time motion analysis techniques have developed. In the 1970s all the research in this area was done through real-time analysis, while these days almost all of the research in this field is based on video-recordings (Table 1 – Time-motion analysis through the years). Strengths of time-motion analysis on video basis are the increase in accuracy in the data collection and the simple fact that it is possible to re-analyze the data. Depending on the number of categories in which the athlete behavior is divided, analysis can take a lot of time. This is one of the weaknesses of a video-based approach.

Year:	Sport:	Author(s):	Time-motion analysis based on video or real-time analysis:
1974	Australian football	Jaques and Pavia	Real-time analysis
1976	Football / soccer	Reilly and Thomas	Real-time analysis
1976	Ice hockey	Green et al	Real-time analysis
1985	Football / soccer	Mayhem and Wenger	Video analysis
1988	Soccer / Rugby un.	Treadwell	Video analysis
1988	Rugby union	Docherty et al	Video analysis
1991	Football / soccer	Bangsbo et al	Video analysis
1993	Rugby league	Meir et al	Video analysis
1994	Field hockey	Boyle et al	Real-time analysis
2004	Super 12 rugby	Duthie et al	Video analysis
2004	Field hockey	Spencer et al	Video analysis
2004	Australian football	Dawson et al	Video analysis
2005	Field hockey	Spencer et al	Video analysis
2006	Rugby union	Roberts et al	Video analysis
2007	Volleyball	Sheppard et al	Video analysis
2007	Rugby union	Deutsch et al	Video analysis
2007	Field hockey	MacLeod et al	Video analysis
2007	Cricket	Rudkin and O'Donoghue	Real-time analysis
2008	Futsal	Barbero-Alvarez et al	Video analysis
2009	Water polo	Tan et al	Video analysis
2009	Basketball	Matthew and Delextrat	Video analysis

Table 1 – Time-motion analysis research from 1974 to 2009.

Duthie et al (2003) have looked into the reliability of time-motion analysis based on video recordings. One observer looked at footage of a match in super 12 rugby on two occasions one month apart. The researcher looked at the number of times a certain action (jogging, striding, being stationary, etcetera) was performed during a match and the duration that was spend in total, performing these actions. The researchers used TEM (typical error of measurement) as their measurement of reliability, with <5% being rated as good, 5-9.9% as moderate and higher than 10% being poor (these numbers were also used in an earlier study by McInnes (1995)). The total time spent in each individual action was 5.8-11.1% (rated moderate to poor) and the frequency of times a certain action was performed was rated 4.3-13.6% (rated good to poor) and the means where rated 7.1-9.3%, being moderate. The results therefore showed that time-motion analysis in this form of rugby was moderately reliable when performed by an experienced observer, but can still be used for qualitative or semi-qualitative analysis of player movement in a practical setting.

One other area in which observational techniques are commonly used is the area of coaching behavior. Rosado and Mesquita (2009) looked at coaching behavior towards players with different status in basketball in Portugal. They filmed coaching behavior and concluded that coaches behave differently with players of the same team, according to their game capacities.

In one other study in 2008, Becker and Wrisberg researched top basketball coach Pat Summers' behavior. They used the Arizona State University Observation Instrument (ASUOI; Lacy and Darst, 1984). This model is widely used within coaching behavior studies. It is comprised of 13 behavioral categories which represent three general types of behavior: instructional, non-instructional and dual codes (behavior that includes mentioning the name of the recipient). They concluded that most of Summers' coaching behaviors where instructional, positive and hustle oriented.

The Coaching Behaviour Assessment System (CBAS, Smith et al, 1977) is another method to examine the behaviour of coaches in practice, consisting of 12 behavioural categories. This model is often used to compare the coach's behaviour with the athlete's perception of the coach's behaviour.

3.2.4 Observational research method in the present study

Based on previous research and relevant ethical considerations, direct observation was chosen as the preferred observational research method. A bespoke behaviour observation form was designed to record behaviours observed during warm-up. The design and specifications of this form will be discussed further in chapter 3.8.1 and the form itself can be found in Appendix A.

3.2.5 Methodology in coach learning

Now that we know how behavior in this particular field within sport has been researched throughout the years, a deeper understanding can be gained of how coaches learn and use the theory that is presented by research into practice. Coach learning behavior has been researched in many different ways. As Lemyre (2007) and colleagues mention in their study;

'Using interviews, Fleurance and Cotteaux (1999) studied 10 coaches from different disciplines in France; Irwin, Hanton, and Kerwin (2004) looked at 16 gymnastics coaches in England; Jones, Armour, and Potrac (2004) interviewed 8 coaches from different sports in England, Australia, and New Zealand; Salmela (1996) studied 22 coaches from team sports in Canada; and Gould, Giannini, Krane, and Hodge (1990) surveyed 130 coaches in the United States.' (Lemyre et al, 2007, p. 191).

In all these studies, different methods to research coach learning styles have been used. Irwin et al (2004) used semi-structured interviews, Jones et al (2004) used an interview framework to, but Gould et al (1990) used a questionnaire with objective and open questions. Lemyre and colleagues used interviews on a more narrative basis and made coaches tell their live stories (2007). Different methods of collecting the necessary data depend on sample size and the exact goal of the study. Interviews with coaches gain a deeper understanding of the background knowledge coaches may have in the field, but take more time, while questionnaires are more suitable for a bigger sample of coaches.

The strengths of interviews, compared to other methods of data collection are:

- A richer and deeper understanding of the data (Trochim, 2006). Because of the open ended nature of the questions in most interviews. It gives the participants a good option of telling their story without being limited to a number of preset answers (Wimmer and Dominick, 1997). It gives the participants the feeling to be in control.
- Interviews ask certain openness from the participants. It is not as easy to give socially desirable answers, compared to a questionnaire (Richman et al, 1999).
- Most of the time interviews give the possibility to answer follow up questions to get a deeper insight in certain matters, although this is not possible in any type of interview. This will be discussed later in this paper.
- Because of the personal contact between the researcher and the interviewees a high response rate is often obtainable.

When conducting interviews with coaches, there are a number of options to choose from with regards to the interview design. Kvale (1996, p. 14) regarded interviews as ‘an interchange of views between two or more people on a topic of mutual interest’. The

interviewee provides the data and it is very important for the researcher to not bias the results. Therefore, the researcher's view during the interview should be neutral.

Different types of interviews that the researchers may choose to use for the study are:

1. Structured interviews

   This type of interview is also known as standardized interview. In this type of interviews, each question is asked to each interviewee in exactly the same way (Corbetta, 2003). That way, the researchers can't influence the data given as a response by the interviewee. One of the strengths of this approach is that the researchers control the subjects. Of the downsides is that there is no option to probe for information that might come up and would be relevant to explore in depth. Irwin et al (2004) used this approach in their study in gymnastic coaches.

2. Semi-structured interviews

   In a semi-structured, or non-standardized interview, the researcher has a set of subjects and questions he would like to cover, but he can deviate from that, depending on the direction of the interview. The wording and the order of topics and question may vary (Corbetta, 2003). The strength of this approach is the fact that new information that comes up can be explored in depth. One of the drawbacks is the difficulty to formulate relevant questions if the interviewee comes up with new information and keep the flow of the conversation going. This method was used in research in sport by Jones and colleagues in 2004 when they did research at coach learning styles on eight coaches in England, Australia and New Zealand.

3. Unstructured interviews

   Interviews on an unstructured basis do not use an interview guide. This type if interviews is more informal than the first two. It is important for the researchers to ask open questions in which the interviewee can express his views and opinion on the

matter. The difficulty for the interviewer is to come up with the right questions to get to the information he is trying to gather. One of the drawbacks is that it is difficult for inexperienced interviewers to come up with the right questions. This type of interviews is commonly used when there is not a lot of data on the subject that is researched.

4. Non-directive interviews

   In a non-directive interview, the interviewer just has a subject and an idea about where he wants to go with the interview, but there are no set questions. The interviewee is in charge and the interviewer listens (Gray, 2004). Because there are no set questions and the interview can go anywhere from start to finish, it is hard to analyze the data, which is a downside. This method is mostly used in psychology to find someone's deeper problems or feelings (Corbetta, 2003). A more narrative approach, like Lemyre (2007) and colleagues chose for their study on youth coaches in sport falls under this category.

3.2.6 Interview techniques in the present study

Based on the earlier review of available interview techniques, a semi-structured interview protocol was chosen for use in the present study. The semi-structured interview protocol gives rich data and allows the researcher to probe for more information if interesting topics emerge from the answer of the interviewee (Trochim, 2006). Detailed information regarding the interview schedule and protocol for the present study can be found in chapter 3.8.2.

3.3 Mixed Methods approach

The methodology for the present study was designed utilizing the knowledge gained from the earlier review of the strengths and weaknesses of the methods applied in previous

research. O'Leary (2004, p. 150) remarks 'Collecting credible data is a tough task, and it is worth remembering that one method of data collection is not inherently better than another.' Even though O'Leary mentions that one method is not inherently better than another, it is important to pick the best possible method for the upcoming study. This can also mean that a mix of different methods can be used, to come to an optimal result.

Combining both observations and interviews with coaches will lead to a mixed methods approach. This is a mix of qualitative and quantitative data collection. Johnson and colleagues (2007) tried to define the term 'mixed methods' in their research. They reviewed the literature in the field and had a discussion with professionals, to come up with one definition. They combined 19 previous definitions into one definition, which is as follows (Johnson et al, 2007, p. 129):

'Mixed methods research is (…) based on qualitative and quantitative research; it is the third methodological or research paradigm (…) that often will provide the most informative, complete, balanced, and useful research results'. A mixed methods approach is the least common approach to conducting research and is also described in research as the third research paradigm (Johnson and Onwuegbuzie, 2004). The two dominant research paradigms, qualitative and quantitative research, have led to two different research cultures where one acknowledges the superiority of deep, rich observational data (qualitative) and the other one preaches the value of hard, generalizable data (Sieber, 1973).

There are purists on both the quantitative side as well as the qualitative side. Even though the two paradigms are far apart, they have agreed on a number of important issues. Examples are the fact that something that is noticed and observed is influenced by one's background. Secondly a hypothesis cannot be tested in complete isolation since there are always various assumptions that have to be made. And thridly the fact that researchers are always influenced by their backgrounds, values and beliefs (Johnson and Onwuegbuzie, 2004).

The main idea behind positivism is the fact that the observers are neutral collectors of data without influencing the world in which they collect their data (Johnson and Cassell, 2001). Constructivists however, believe that this data can only be presented through our own interpretation of this data (Stenner and Brown, 1998). This shows the conflicting philosophical positions between the two paradigms. The methodology of the present study however, uses the results of the observations (quantitative) to complement and provide additional insights to the interpretation of the results of the interviews (qualitative) and vice versa.

The goal of a mixed methods approach however, is not to replace one of the two paradigms, but to draw from the strengths of both in order to minimize the weaknesses and create an effective method to answer important research questions (Johnson and Onwuegbuzie, 2004). The research world is becoming more and more complex and by combining the best of both paradigms a researcher stands the best change to find the answer he seeks (Johnson and Onwuegbuzie, 2004).

The strengths of a mixed methods approach are numerous (Greene et al, 1989). First of all it combines depth and breadth. In the upcoming study this is translated to the observation of many teams (breadth) and in depth interviews with coaches (depth). Second is the idea of complementarity. This means that results from one method are clarified by the use of the other method. The third strength is expansion which provides richness in detail because of the use of a combination of two methods.

This third research paradigm combines the strengths of qualitative research with the strengths of quantitative research. By combining in depth data collected from interviews or questionnaires with quick, precise and possibly numerical data, strengths of both research paradigms are being utilized (Johnson and Onwuegbuzie, 2004).

This study could benefit from the strengths of both the qualitative and the quantitative research paradigm by combining these into a mixed methods approach. The pragmatic approach chosen was valuable in addressing the research goals because the pragmatic approach places high value on reality and real world research. It views the truth as a value that changes over time.

3.4 The researcher

The researcher has played field hockey in The Netherlands for 12 years in and is still active as a player. He has always played at grassroots level. He has been a coach in the sport for 4 years, coaching youth teams that played on a semi professional level. His coaching knowledge mainly comes from mentoring by other coaches at different clubs, and by reading books and articles about coaching in this sport. He has been on one short, introductory coaching course for youth coaches in The Netherlands. From a young age the researcher has been active in a large number of sports, such as tennis, baseball and water polo. When aged 11 years old the researcher started playing field hockey. He spent around 5 hours a week playing the game. When he started coaching at age 16 he gave up other sports and invested around 5 hours a week in training and coaching the team he coached.

The researcher studied in the North of The Netherlands to become a Physical Activity and Lifestyle Counsellor; meaning he coaches people to a healthy lifestyle using sport, to improve their quality of life. During this course, he followed an internship at a regional semi professional club, which was coached by a coach who is seen as one of the three best coaches in The Netherlands by people in Dutch hockey.

3.5 The pilot study

To get a closer look at the relevance of the methods, a pilot study was carried out. The purpose of this pilot study was to improve the quality and efficiency of the main study, as well as analyzing the research strategy (Lancaster et al, 2004). The aims of the pilot study where formulated as;

- Testing the observational instrument that was created for the study and practice the observational techniques that will be used in the main study, to create a higher validity.
- Testing of the semi-structured interview protocol and practising the interview technique that will be used during the main study.

After the pilot study, it became clear that a couple of actions were missing on the initial observer instrument. Actions 'Hurdle hops, Skipping, Lunges, Sumo's and the Wave on Goal' were added to the observer instrument, since these were not on the initial observer instrument. That way the observer instrument became more complete and easier to fill out during subsequent observations for the main study. One of the practical implications that resulted from the pilot study was the location of the observer. During the pilot study, the observer made his observations from the center dug out on the pitch. From a practical point of view it became clear that a higher location would be more suitable for the observations, because of a better view.

Finally, the interview protocol was slightly adjusted after the pilot study, by changing the wording of some of the questions, making them slightly more open ended. A question formulated as:

"What happens to the structure of the warm-up when the match is delayed and you've already started the warm-up? Which part is extended?"

Was changed into the more open ended question:

"How do you adapt the structure of the warm-up if and when matches are delayed?"

Lancaster et al (2004) state in their paper on pilot studies that 'participants in an external pilot should not later be included in the main study' (p. 311). They reason that the decision to proceed with the main study would not be made independently of the pilot study, if one would first look at the results of the pilot study. Therefore the team that has been used for the pilot study will not be included in the main study.

3.6 Data collection timeline

The following table will contains a timeline of all the activities planned and carried out during the collection of the observational and interview data.

Time:	**Action:**
Week before the match.	Coaches of participating teams would be contacted to schedule a time to meet before the game in which informed consent would be obtained and the data collection process would be explained. Coaches would also be notified of the fact that the researcher would like to conduct an interview with the coach.
1:00 pm	The researcher would arrive at the facilities to meet one or both coaches. This depended on whether both teams participated in the study or just one. Coaches would sign the consent form to give their informed consent and the data collection process would be explained again.
1:15 – 1:30 pm	Teams would start their warm-up. Observational data was collected from the moment the team entered the pitch till the moment the match commenced.
2:00 pm	Start of the match and ending of observational data collection.
3:15 – 3:30 pm	After the match had ended, the coach would do all of his post-match analysis and business he had to take care of with regard to his players and formalities concerning the officials, opponents, etc.
3:30 – 4:00 pm	The interviews with one or both coaches would be conducted after the coaches finished their other formalities and had time for this. In one case the interview was conducted the day after match day.

Tabel 2 – Data collection timeline.

3.7 Participants

To achieve a high level of knowledge, the researcher decided to only include teams of National League and Premier Division level in the study. To get a broad view of hockey warm-ups on an elite level, both male and female teams and their coaches were included in the study.

3.7.1 Sample and sampling criteria

A total of 20 teams were contacted by e-mail with a request to participate in the study. If they did not reply to this within two weeks, there were contacted by phone, to confirm potential interest in participating. A total of 13 teams positively replied to the invites and took part in the study. The 13 teams consisted of 8 male and 5 female teams. From the male teams, two of the teams were active in the Premier Division, while the rest of the male teams were active in the National League. From the female teams, three of the teams were active in the Premier Division, and two of them played in the National League. All these details are taken from the league they played in, in season 2009 – 2010. From the whole sample of 13 teams, 10 coaches or warm-up leaders agreed on being interviewed about their background knowledge and choices in warm-up design. The other 3 coaches either chose not to be interviewed or could not be reached to make an appointment. None of the 13 teams withdrew from the study.

For the sampling of the participating teams, convenience sampling was used. Even though random sampling would be the preferred method to select the sample for the present study (Krathwohl, 1993), convenience sampling was chosen as sampling method to save the researcher valuable time. This sampling method would still provide a very wide, representative sample since a lot of teams would either play at home or away in the West Midlands in the 2009 – 2010 season. All the teams that played on National League or a higher

level in the West Midlands area in England were approached by e-mail to voluntarily take part in the study. Confidentiality was maintained by allocating each team a code. All codes can be found in chapter 3.6.2 in Table 2.

3.7.2 Short information about the participating teams

Team:	**Sex (M / F):**	**Level of play:**	**Position 2009 – 2010*:**
I	Male	National League	Bottom half
II	Female	Premier Division	Top half
III	Male	National League	Bottom half
IV	Male	National League	Bottom half
V	Female	Premier Division	Top half
VI	Male	Premier Division	Bottom half
VII	Female	National League	Top half
VIII	Male	Premier Division	Top half
IX	Male	National League	Top half
X	Male	National League	Top half
XI	Female	Premier Division	Top half
XII	Male	National League	Top half
XIII	Female	National League	Top half

Table 3 – Information sheet about the participating teams. ***** *Each league consists of 10 teams, meaning the top half being 1st till 5th position at the end of the season and bottom half being 6th till 10th position.*

3.7 Ethical considerations

3.7.1 Consent

Research involving human beings means that ethical considerations have to be made (Robson, 2002). After coaches agreed to participate in the study, they signed a 'Consent form' the first time they met the researcher in the field. The consent form can be found in appendix D (chapter 6.4). It outlines that coaches have been informed about the purpose of the study and the fact that all information will be handled in a confidential way. It also shows coaches they have the right to withdraw from the study at any point, without this having any affect on their treatment. All of this information was presented to the coaches in an 'Information sheet' (Appendix E, chapter 6.5). This information sheet gives the participants a short outline of the purpose of the study. Previous to the data collection, the ethical approval of the University of Birmingham ethics committee was obtained.

3.7.2 Protection of confidential information

To maintain participant confidentiality, all research documents were stored on a password protected computer. This is in accordance with the Data Protection Act (1998), which states that privacy of personal information should be protected and can only be used for the specific purpose for which it was collected. To further ensure the confidentiality of the research data all teams were allocated codes in place of their team names. By using this method information cannot be traced back to a specific team. Anonymity could not be guaranteed since the researcher knows which data belongs to which team.

3.8 Data collection

3.8.1 Use and design of the Behaviour Observation form

Data on actions that each team performed during the warm-up was collected using an observer instrument (Appendix A, chapter 6.1) that was designed for the purpose of this study. All actions that can be expected during a warm-up in field hockey were present on this form. The list of actions was drawn up from the researcher's experience in the sport, combined with a small number of actions that came up during the pilot study. By completing the Behaviour Observation form during the warm-up, the researcher can compile a timeline of the warm-up.

Before observing a team during their warm-up, an appointment with the coach was made. As a reminder, the coach was notified of the presence of the researcher on the day the observations would take place. All contact with players was avoided on the day of the observation, since this was part of the terms in the information sheet that was handed out to coaches before the observations would start ('Your athletes will not be distracted in any way during their warm-up').

Observations started from the moment the players started their warm-up. Players' actions were observed and noted down every 30 seconds, using a stopwatch (Fastime 20) to keep time and by tallying their actions on the Behaviour Observation form. The data collection of the warm-up finished when the players started their match (push back). The tallying of the actions was done with different coloured pens. This made analyzing timings and order of actions possible after the data collection. After collection, the data was recorded in a Microsoft excel sheet (Appendix B, chapter 6.2) which showed a timeline and the actions performed during the warm-up. By using this method warm-ups could later be analyzed and compared.

3.8.2 Interview data

A semi-structured interview protocol was designed in order to acquire the information that was required for the present study. Interviews give a richer and deeper understanding of the data (Trochim, 2006), because of the open ended nature of most questions and the possibility for the researcher to probe for deeper information. Interviews are the best way of looking at the background of coaches in a specific area, particularly in a relatively small study size ($n < 15$) such as this.

Other advantages of this approach are:

- New information that comes up from the standard questions can be explored in depth.
- By having a standardized set of questions, it is relatively easy for a researcher with little experience as an interviewer to keep the conversation going if new information comes up.
- Analyzing the data takes a relatively short time, since the questions are relatively standard, compared to unstructured and non-directive interviews. Compared to structured interviews, the data gained will be a lot more in depth.

All interview questions were designed around the background of the coaches and the choices they made in the design of the warm-up. The semi-structured interview protocol that was used can be found in Appendix C (chapter 6.3). This protocol was used as a guideline in each interview, to improve consistency and to guarantee that no questions were overlooked. However, when another interesting area would open up, the researcher could easily probe into this or change the order of the questions.

Interviews with the coach or warm-up leader would take place at a time of the coach's convenience. The coach or warm-up leader was asked for permission to record the interview,

in order to let the researcher fully focus on the participating coach and to make sure all given information was taken on board. All coaches agreed on this matter.

The interviews with the coaches would take between 7 and 15 minutes. Interviews were conducted face to face and recorded using a digital audio recorder (Olympus DM-20 Voice and Music) and would be transcribed to a text document using a Microsoft Word, for later analysis.

3.9 Observational data analysis

3.9.1 A framework for field hockey warm-ups

Data of all observations was inserted into Microsoft Excel files to analyze. A framework was formed to split the warm-up into key phases, using the 'RAMP' method by Jeffreys (2007). Jeffreys writes about the different phases in a warm-up as being:

- Raise: using low intensity activities to elevate the body temperature, heart rate, respiration rate, blood flow and joint viscosity. Ideally this phase would consist of movement skills or sport specific skills that would also be used in a particular sport, while still providing the elevation element in the warm-up.
- Activate and mobilize: in this phase the athlete needs to activate key muscle groups and mobilize key joints and ranges of motion. The focus is not on individual muscles, but on movements as a whole, since this is less time consuming and more sport specific. By moving the whole body during these exercises, the elevation reached in the raise phase can be maintained.
- Potentiation: this phase has the goal to improve the effectiveness of subsequent performance and will normally involve sport specific exercises of increasing intensity. After this phase, athletes will be able to achieve their peak performance when the match or training session begins.

It is possible to apply this system to field hockey. First, the raise phase can be considered the gentle jog around the pitch which is a common element in field hockey warm-ups. The athlete then proceeds to the activate and mobilize phase. This phase ensures that the elevation in temperature achieved in the first phase will be maintained. During this phase sport-specific stretches and exercises should be included in order to activate key muscle groups that are needed to perform in the match or training session that follows and to increase the range of motion of key joints used in hockey. Examples of stretches and exercises that one might expect in this phase are e.g. lunges, sumo's, high knee's, cross-overs, and others. Intensity will gradually increase during this phase, and will continue to do so during the phase that follows.

The final phase of the warm up is the potentiation phase. During this phase activities become even more sport-specific and as such the hockey stick and ball are introduced and the intensity approaches match intensity. Typical elements of this phase involve passing between players, shooting at goal and simulated small-scale matches.

Figure 1 – Different phases during a warm-up

3.9.2 Recovery

Recovery-intensity activities are integral elements in each phase. In the framework in figure X this is shown by the R, integrated in each phase. First, the purpose of recovery in

each separate phase will be discussed. Activities that can be seen as recovery are taking of track suits, having a drink, team talks and walking in between activities. In the final phase, taking positions is a recovery element too.

3.9.2.1 Recovery during the raise phase

As mentioned before, the purpose of the raise phase is to elevate the body's temperature. Recovery is therefore a less important aspect in this phase. The intensity of the activities is relatively low compared to the intensity the athlete is working towards near the end of the warm-up.

3.9.2.2 Recovery during the activate and mobilize phase

By focusing on movements as a whole, the elevation reached in the raise phase will be maintained. The intensity in this phase is higher compared to the raise phase and because of that the athletes will need more recovery in order not to get fatigued. Because of the higher intensity in this phase, intensity of the recovery activities can be higher compared to the first phase as well. An example of this is jogging. Where this is seen as raise in the first phase, it can be seen as recovery in the second phase, because the overall intensity of the activate and mobilize phase is higher.

3.9.2.3 Recovery during the potentiation phase

In this final phase the athlete is working towards the intensity at which he or she will be performing in the upcoming match or training session. Since the intensity in this phase is the highest in whole of the warm-up the athlete needs the most recovery in order to achieve his or her peak performance before the match or training session begins. The intensity of the recovery elements in this phase is comparable to those in the activate and mobilize phase.

3.9.3 Data analysis

Each warm-up would be divided into the key phases that are mentioned in chapter 3.8.1. The total duration of each warm-up was recorded as well as the time spent in each particular phase. By using this method direct comparison and analysis could be made between all participating teams' warm-ups and the conceptual warm-up discussed in the literature review. The results can be found in chapter 4.

3.10 Interview data analysis

All 10 interviews were transcribed into text files and individually analyzed. After reading all interview transcripts twice, the data analysis would begin. Category codes were developed during the analysis of the transcripts to organize all the data and discover the repeating ideas that emerged from the data (Bogdan and Biklin, 1998). All of the coaches' quotes that were relevant to the study were assembled in an empty Microsoft Word file, in which they were grouped by subject. An example of a quote was, for instance: 'In case of a delay, the players just get some warm clothing on'. This would fit in the category 'Passive warm-up techniques'.The code that matched this category is 0008 (See Figure X).

The following categories were obtained from the raw interview data and given a code:

Category:	**Code:**	**Category:**	**Code:**
Selection of warm-up leader	0001	Passive warm-up techniques	0008
Background knowledge	0002	Possession game in warm-up	0009
Percentage mental / physical	0003	Warm-up development	0010
Stretching during warm-up	0004	Indiv. Influence on warm-up	0011
Change of act. during season	0005	Indiv. Warm-up vs. Team warm-up	0012
Warm-up duration	0006	Relation between training / match	0013
Structure in case of delay	0007		

Table 4 – Table with all categories and their codes used during the interview data analysis.

At first, a general name would be assigned to a certain number of ideas that were related, before giving the category its final name. While more transcripts would be analyzed, more quotes were added to each different category. More categories would emerge until all interviews were analyzed. A category could then be divided into a number of sub-categories. The category ‘Change of warm-up activities during the season’ was divided in different reasons for change of activities, such as ‘Boredom’, ‘Opposition’ and ‘Results’. The last phase of the process was the critical evaluation of the content of each category to see if the content still matched the category title and vice versa. If a quote would be more appropriate in a different category it would be transferred to this category. In one occasion a category was

divided into two new, separate categories, because of the two different ideas that emerged from the contents of this category.

3.11 Chapter conclusion

Little research has been carried out in the area of warm-ups in field hockey. This chapter outlined how the small amount of previous research influenced the choices of the researcher in constructing the research methods for the present study. By combining observations and semi-structured interviews, a mixed methods approach was created. The participating teams and their level of play were introduced, before describing the methods of data collection and analysis. By using these methods data can be collected in practice before this can be compared to the image of a warm-up that was formed out of literature in the previous chapter.

CHAPTER 4: RESULTS and DISCUSSION

4.1 Introduction to the chapter

This chapter will present and discuss the results that originate from the findings of both the observational research data and the semi-structured interviews and relate them to previous research. Combining these findings will create an image of the way warm-ups are executed at the National League and Premier Division level during the 2009–2010 season. Through the qualitative data that came from the interviews one can gain a deeper insight about the way coaches make their choices relative to the structure and design of the warm-up. Overall, this results in seven areas that are impacted on during the warm-up. These seven areas will be discussed in this chapter. First warm-up duration and the different phases within the warm-up are addressed. Secondly, the athlete's individual influence on his own warm-up and the mental and physical importance of the warm-up will be explored. Thirdly, changes in warm-up structure during the season and in case of a delay before the match will be discussed. Finally, different elements of stretching that have been observed during the warm-ups will be explored.

In these seven areas, possible similarities or discrepancies between the findings of both the observational research data and the semi-structured interviews will be examined. Throughout this discussion, research findings resulting from the present study will be related to previous research.

4.2 Coach's backgrounds

It is important to see where coaches gain their knowledge. Côté (2006) states there are 3 different settings in which coaches learn to coach which are:

- Coaching education programs: Gilbert et al (2006) and Gould et al (1990) have shown that effective coaches spend time on official coaching programs every year. Coaching programs could be made more effective by taking a more practical approach to coaching courses as opposed to the scientific information which forms the basis of most of today's coach education programs. Coaches need help translating the theory and research elements of the courses into practice in the field.
- Experiences as a coach: studies by Salmela (1996) and Gilbert and Trudel (2001) suggest coaches learn best through practical coaching experience. Coaches increase their knowledge base as well as mature via their practical experience during their career.
- Experiences as an athlete: if coaches have previously competed in one of more sports they benefit from the time they have spent being coached themselves. By experiencing the direction of a variety of coaches an athlete is able to develop a firm image of what they view as a good coach. During his coaching career the coach can aspire to conform to this image or duplicate successful techniques.

The majority of the coaches declared they gained most of their knowledge through previous experiences as a player and a coach. Only one coach (team III) mentioned a coaching course he attended, but even he declared that personal experiences were the most important aspect of becoming a good coach. Experiences as a player, captain or coach were mentioned as contributing to the choices of warm-up activities and a coach perception of the game itself. A second background influence was the coach or warm-up leader's occupation or educational background. The warm-up leader of team X said:

> "I'm a P.E. [*Physical Education*] teacher so I obviously think I know a little bit about trying to prepare yourself for performance." – (Warm-up leader team X).

A job centered on the area of physical activity and sport demonstrates that one has a wide knowledge in the field. This knowledge can be used to benefit the team during training sessions and in preparation for matches. Another theme that emerges from this question is the professionalization of sport and sports coaching. Taylor & Garratt (2010) mention the UK Sport report (2001) in which UK Sport states that sports coaching standards should be elevated to those of a profession central to the development of sport. A coach needs to be open to new forms of training and knowledge. In the present study, one of the teams included a strength and conditioning coach as a member of staff. The coach of this team commented:

> "I have some experience [*background in the area of warm-up*], but since I like to run the side as a professional, it's not something I feel I'm a professional in, so then I get somebody to do that. So the warm-up is designed by the strength and conditioning coach." – (Coach team VI).

Another example of the 'professional' attitude a coach needs to have towards the acquisition of new forms of knowledge (Taylor & Garratt, 2010) is utilizing the most up to date research to optimize the warm-up structure and increase performance. The coach of team II stated:

> "We do a lot of work with a Sports Science Department, and they give us a lot of help and guidance in what we need to do." – (Coach team II).

He explained that the staff of his team would meet with researchers from the University Sports Science Department if there was any valuable or relevant new material that could be of interest to the team.

4.3 Warm-up duration

A major point that came up during the present study is the duration of the warm-up. After the warm-up an athlete should have increased mental focus and increased body and muscle temperature and as well as a readiness for the forthcoming tasks of the training session for the task-specific activities that the athlete is about to take place in (Cone, 2007). However, it is important that the warm-up should not last too long since this might fatigue the athletes, causing a decrease in performance rather than the improvement a coach would aim for through a dynamic warm-up.

In Table 3 an overview is given of the duration of the warm-up of all teams that have been observed in the present study. The average duration of the warm-up is 35 minutes and 40 seconds (± 4 minutes and 20 seconds). As mentioned in the literature review chapter, no research has been conducted on warm-up duration in field hockey. Pasanen et al. (2009) carried out a study in which they examined the effects of a neuromuscular training intervention as a warm-up session to enhance motor skills and prepare the body for training in floorball players. Their warm-up session lasted between 20 and 30 minutes and consisted of four exercises, like running speed, balance control and lower limb strength exercises. The researchers found no significant effect on running speed and agility, but did find some positive effects on balance. This could possible demonstrate that a warm-up of 20 to 30 minutes would be too short to cause any performance increasing changes. Since there is a clear gap in literature in this particular field, these results need validation through other studies that investigate the fact whether 35 minutes would be a good duration for a warm-up.

All values lie within two standard deviations of the mean (between 26 minutes and 45 minutes and 20 seconds). This shows that the average warm-up value is a nice representation of the whole study population.

Team:	**Warm-up Duration**	**Team**	**Warm-up duration**
I	37:00	VIII	32:00
II	35:00	IX	39:00
III	42:00	X	30:00
IV	35:00	XI	30:00
V	33:00	XII	31:00
VI	39:00	XIII	39:00
VII	42:00	**Average**:	35:40

Table 5 – Warm-up durations of all teams that participated in the present study.

A number of interesting points emerged during the interviews when asking coaches about what they considered the perfect duration for a warm-up. Of the teams that were interviewed, the majority actually warmed up for less time than they claimed was the perfect duration. Out of the 8 coaches that replied to the question of what the ideal duration for the warm-up was, 6 gave a higher duration than was observed in practice. Ideal duration, compared to actual times seen in practice is shown in Table 4. It is clear from the answers the coaches gave that they all use a standard timeline for the timing of the warm-up:

> "We normally go for a run for 5 minutes, than do some dynamic work for about 10 or 11 minutes and then the last 6 minutes would be some agility work. After that stick and ball for 23 minutes, so the whole warm-up is structured for 45 minutes." – (Coach team VI).

"We tend to start 35 minutes out from the pushback time. Ten to fifteen is the physical warm-up, the stretching and so on and then we tend to do sort of 10 to 15 again on stick and ball, corners and get a 5 aside small game in there as well. Anything longer than 35 minutes tends to make them tired or make it go stale and any shorter and you feel rushed. That sort of 35 minutes works for us." – (Coach team VIII).

Team:	**Warm-up Duration (MM:SS)**		**Team**	**Warm-up duration**	
	In practice:	Ideal according		In practice:	Ideal according
I	37:00	N.A.	VIII	32:00	35:00
II	35:00	45:00	IX	39:00	N.A.
III	42:00	45:00	X	30:00	35:00
IV	35:00	N.A.	XI	30:00	35:00
V	33:00	N.A.	XII	31:00	30:00
VI	39:00	45:00	XIII	39:00	N.A.
VII	42:00	35:00	**Average**:	35:40	38:10

Table 6 – Duration of the warm-up as observed in practice, compared to the duration the team's coach mentioned as being ideal for the warm-up.

4.4 Warm-up phases

An overview of the time spend in each of the key phases of the warm-up is given in Table 5. In all but one team the Raise phase is the shortest phase in the warm-up. This can be explained due to the fact that the primary function of the Raise phase is elevating the body's temperature and processes. This elevation process will continue during the activate and mobilize phase. The transfer from phase one to phase two is therefore not as clear as the transition between phase 2 to phase 3.

Team:	Raise:	Activate / Mobilize:	Potentiat	Total:
I	2:30	10:00	24:30	37:00
II	7:00	6:00	22:00	35:00
III	2:00	11:30	28:30	42:00
IV	2:30	10:00	22:30	35:00
V	2:30	16:30	14:00	33:00
VI	3:30	10:00	25:30	39:00
VII	3:30	19:30	20:00	42:00
VIII	2:30	15:30	16:00	32:00
IX	2:00	13:30	23:30	39:00
X	2:30	7:30	20:00	30:00
XI	1:30	14:00	14:30	30:00
XII	1:30	9:00	20:30	31:00
XIII	1:30	13:30	24:00	39:00
Average:	2:41	12:02	20:57	35:40

Table 7 – Time (in minutes) spend in each phase and total warm-up time.

On average, teams spend about 15 minutes in the first two phases, before they move on to the hockey specific potentiation phase. This could be expected from previous literature, since the duration of the physical element in the warm-up should be between 5 and 20 minutes (Franks, 1983). The players spend about 21 minutes in the potentiation phase, before the match starts.

Coaches assigned different value to the utility of the physical segment of the warm-up (the raise phase and the activate and mobilize phase) as opposed to the hockey specific section (the potentiation phase). One coach stated:

> "You tend to always have a decent physical warm-up. And most of the guys play their hockey and if they don't have a perfect warm-up than that's not too much of a loss." – (Coach team VIII).

Another coach mentioned exactly the opposite:

> "Just always make sure you have the same amount of pitch time. The hockey specific warm-up is the important bit." – (Coach team II).

4.5 Individual warm-up

As mentioned in the literature review chapter, there is a potential need to tailor warm-ups to the individual instead of just designing a team warm-up. Woods (2007) mentions that warm-ups should be designed to the needs of the individual athlete, depending on physical condition. During the observations it became clear that most of the teams had a central team-warm-up. The first two phases of the warm-up were executed as a team, but the potentiation phase was quite individual by times. A small group of players doing a variety of different warm-up elements was a common observation. Some players would practice short corners while others were active in a 5 aside game or practicing long passes over the length of the pitch. This made the observations by times a little bit chaotic. During at least 3 of the interviews with the coaches this topic came up. The coaches mentioned that it is important for the athletes to prepare themselves in the best possible way for their upcoming performance. From previous experience as players the coaches knew that athletes are experienced enough to know what their bodies need. This also demonstrates again that coaches' previous experience is important in determining what their advice as a coach looks like. Côté (2006) mentions the

importance of experience as an athlete in becoming a successful coach. Jones et al. (2003) talked about a professional football coach that also used his previous experience in dealing with the athletes in his team. One of the coaches in the present study explained:

> "I must admit, I'm not a great fan of team warm-ups because I know as a player myself that I much prefer to do certain things than to have to do what somebody else is telling me to do when I don't think that's really specific for my needs and my preparation for the game." – (Coach Team XI).

One other interview shows that some of the coaches and warm-up leaders agree with this. They give their players the freedom and responsibility to tailor the warm-up to their own needs:

> "Not all players prepare for games the same way, so we try to make the warm up fit in with the team's needs… players have the freedom to make the warm-up what they like." – (Coach team XII)

In 4 other interviews coaches mentioned the fact that they always planned two to five minutes during their team warm-up in which the athletes could do any additional, individual exercises they felt were necessary to prepare themselves in the best way for the performance they were about to take place in.

This shows that from a coach's point of view it would be preferable if they designed a team warm-up for their squad of which a portion of time is set aside where athletes can warm-up the way they think is necessary for their body. This time can be filled with hockey specific activities or certain stretches that a player may want to execute.

4.6 Mental and physical importance

In the definition of a warm-up that was given in the literature review, is it mentioned that the warm-up improves both mental and physical readiness. The warm-up should prepare the athlete mentally and physically for the task he is about to take place in (Cone, 2007). One of the objectives of the interviews was to get the coaches' opinion about the importance of both. There was a great variety in the answers to this question. Out of 10 coaches, 4 named the mental aspect as slightly or massively more important, 4 other coaches named the physical aspect as more important and 2 opted for a fifty-fifty. In percentage terms, answers spread out from as much as 90% physical and 10% mental to 70% mental and 30% physical. Averaging out all the scores coaches gave to both aspects, the average score was that they were both equally important. This comparison between mental and physical importance of the warm-up has not been made in any previous studies. Since these are all personal opinions, no hard conclusions can be drawn upon the findings of the interviews, since these answers may not be generalizable to other coaches or other fields of sport. This study however shows that most coaches prefer either the mental of the physical aspect and feel one is more important than the other.

4.6.1 Mental importance

The coach of team II leaned towards the mental side:

"I would probably say, it's probably a sixty-forty mental. I would say personally, because for me warm-up is to make sure you are ready, that when the whistle goes for the start, the players are ready. Now physically they should be that way inclined because of all the training they do, so they should be quite fit and they should be everything else, so that's just getting

the muscles warm. The mental side of it is something where all players are different and you have to make sure that during that period of time it has given them an opportunity to really get themselves focused for a game." – (Coach team II).

One of the other coaches agreed on this matter. He also explained that all the training during the week should make the players physically fit and ready for the game. The final half an hour before the game should be used to go over the goals again and mentally prepare the team for the start of the game.

> "I think that there is too much emphasis put on the need to have a good warm-up to play well. You know, particularly when you start doing stick and ball stuff, if you don't train properly before a game then you are going to play poorly." – (Coach team XI).

This coach explained that the warm-up is the last phase of preparation for a game. According to him, the preparations start from the moment training begins during the week and only end when the warm-up before the game is finished. His colleague agreed on this matter:

> "During the week they will be doing some running, they will be doing some strength and conditioning and everything else, so you know, when you get to the game it's important that you just finish of everything that you're doing." – (Coach team II).

4.6.2 Physical importance

The coaches who concluded the physical element was more important, argued in the opposite direction. They mentioned the last half an hour to an hour before the match was more important from a physical point of view. The coach of team VI said:

> "I think 70-30 [*in percentage terms*], 70% being the physical aspect. The last hour before the game I would say the physical aspect is more important. If you go back any further, sort of 3 or 4 hours before the game, then the mental aspect is more important for the preparation." – (Coach team IV).

These interviews show that the opinion of the coaches was divided. Some of the teams argue that you should be physically fit before you warm-up, using that time to mentally prepare in order to finish the whole week's preparation for the game. This was the opinion of teams such as II, XI and others. Other teams reasoned that you should be mentally prepared before the start of the physical warm-up, giving the warm-up more of a physical purpose. This was the view held by teams such as team VI, IX and other teams. The coach of team IX explained:

> "I would probably say 85-90% physical and the other 10-15% mental. I think mentally you should warm-up before you start the actual warm-up. You should be mentally set when you start doing your physical warm-up." – (Coach team IX).

4.7 Changes in warm-up

Another aspect that came up from the interviews with the coaches was the different reasons a warm-up might be changed either in or off season. When asked if the warm-up design ever changed during the season, most coaches declared it did, but only if there was a

good reason to do so. The main two reasons to change the warm-up structure in or off season were:

4.7.1 Boredom

> "Lately we had a chat and someone highlighted that they get a bit bored of doing the same warm-up before every game. So we do something different sometimes, but the same stretches, in a different form." – (Coach team I).

Boredom is mentioned by 4 out of 10 coaches as an important reason to change the elements of the warm-up. The coach of team I further explained that a warm-up has to mentally prepare the athletes for the match they are about to play. If their players viewed the warm-up as merely a standard routine which they had to go through before they could start playing the coaches would change the warm-up. Two of the other coaches mentioned this in almost the same words:

> "Yes, if we feel it is getting stale, if people are just going through the motions and they are not getting from it what they need to get from it, than we will change it." – (Coach team III).

> "It may change it I feel it is getting a little boring and players are just going through the motions but generally it gets changed between seasons." – (Coach team X).

They all explained that they would not make any major changes to the elements of the warm-up since they all have a different purpose. They would slightly change certain elements by

implementing different exercises that still had the same goal in mind. An example given was a team changing the shooting routine before the match from a 2-man drill to a 3-man drill on goal. Easy changes can be made in the stick and ball section which keep the players fresh. The modified warm-up still strives for the same goals but in a slightly different way. Previous research in the area has mentioned boredom as a negative influence on the warm-up. The warm-up should be functional and could even be a fun way of conditioning (Thomas, 2000). During the observations in this study however, no clear evidence of boredom within teams was noticed. This might be related to the fact that teams were only observed once to collect data for the study.

4.7.2 Results in games

> "If we don't start games positively on a number of occasions then we will sit down and look at it and we'll say: well, you know what: we need to do something different." – (Coach team III).

The other factor that could have an impact on any changes during the warm-up was the result of games. Coaches mainly mentioned the start of the game, which they directly related to the warm-up.

"I can normally tell from the warm-up how we are going to start the game" – (Coach team III).

If the results were negative for a few games in succession, coaches would re-evaluate the warm-up and ask for feedback from their players. Three out of ten teams saw results as an

important contributing factor to any changes that might be made to the warm-up design during the season. Another coach, whose team ended in the top of their league, mentioned there is no need to change a winning team. He stated:

> "I guess there is a bit of mentality wise: if it's working and we are winning: why change it?" – (Coach team X).

4.7.3 Other factors

Other factors that were mentioned by coaches when asked this question, came from a different angle. The coach of team X mentioned the weather as the only reason to change warm-up activities during the season:

> "They [*the warm-up activities*] can change with the weather. The main issue is the weather. If it is very cold I'd like to have a more active warm-up so they have less time to cool down, so less static work." – (Coach team X).

This particular coach would change the warm-up depending on the outside temperature, since this directly influences the body temperature of his athletes. One could think of maintaining the structure of the warm-up and using passive warm-up techniques to keep warm while doing low intensity exercises as another option to prevent players from cooling down. This is also mentioned in chapter 2.4. One other warm-up leader mentioned the fact that their opposition often influenced the way his team would warm-up. He said:

> "Also it seems to change with the opposition we play. If it's a massive game people seem to be a bit more up for a good warm-up. For these matches we do some more

> sprints, because people are so energetic and pumped. So we do the same things, but on different intensities, which I don't think is right, but when you are trying to control 15 other people they do not always listen to me." – (Coach team I).

One other coach stated the opposite in his interview:

> "We never look at the opposition and worry about their process. Match day is about our team." – (Coach team XII).

4.8 Warm-up structure in case of delay

When asked how coaches would adapt the structure of the warm-up in case of an unplanned delay, there were a large number of different responses. Summarized, most teams mentioned they would either:

- Readjust the intensity of the warm-up, but keep the warm-up going or;
- Stop the warm-up and restart it at the moment they knew how long was left exactly.

Both of these reasons were named by most coaches as solutions to the problem, depending on how long the delay was exactly. This showed that the researcher should have phrased his questions more clearly.

4.8.1 Readjust warm-up intensity

The coaches usually used this approach in case of a minor delay of about 10 or 15 minutes. They would lower the intensity of the warm-up and implement a few extra breaks, adding in some time to take on fluids.

> "So we stopped, we took fluids on, we sort of slowed down what we were doing and went into a game situation across the 25 yard area, a bit of two touch, so intensive but not physically massively demanding. And then went through a bit of stick and ball, had bit of a chat, just redefined our goals for the game and then when we knew the exact time he was going to arrive we got back into the normal warm-up in the stage we were at before. If it was cold we would have probably gone back inside the changing room and stayed warm inside and then come back out." – (Coach team X).

As this coach already mentions, the weather is an important deciding factor. When it's cold outside there is a bigger risk of his players cooling down, which makes it more important to stop the warm-up and restart it when there is more clarity on the actual pushback time.

> "So do the warm-up as usual and lengthen the stick and ball warm-up but give them a bit of rest. So basically to keep the muscles firing [*neuromuscular activation*] and then getting ready for the game. If it's a longer delay, maybe talking about more than 10 to 15 minutes we normally stop the warm-up and then we would start it over again." – (Coach team VI).

This once again shows the importance of the timing of the different phases in the warm-up, like mentioned in chapter 4.3.

4.8.2 Stop the warm-up

> "We would stop immediately, a drawn out warm up is worse than no warm up." – (Coach team XI).

A lot of coaches, as with the coach above, would stop the warm-up and wait till there was an exact time of pushback. That way they could reschedule the warm-up and keep the organization intact.

> "So because the whole structure is timed, we just move it back the amount of time that the match is delayed… What they do is they just get some warm clothing on." – (Coach team III).

In this scenario passive warm-up techniques are important again, as mentioned by this coach. During the delay it is important that his players don't cool down.

4.9 Stretching related components

The stretching-related components of a warm-up are discussed as the last subject in this chapter. This subject can be split into two sub categories: static and dynamic stretches. None of the coaches mentioned PNF stretching and therefore this topic will not be discussed in this chapter.

4.9.1 Static stretching

When observing the teams, it became clear that most of the teams used both static and dynamic stretches during their warm-up. An overview of the presence of stretching routines used by all teams is given in Table 6.

Team:	**Static stretches:**	**Dynamic stretches:**
I	YES	YES
II	YES	YES
III	NO	YES
IV	NO	YES
V	YES	YES
VI	YES	YES
VII	YES	YES
VIII	YES	YES
IX	YES	YES
X	YES	YES
XI	YES	YES
XII	NO	YES
XIII	YES	YES
Total:	77%	100%

Table 8 – The use of both static and dynamic stretching for each of the participating teams.

> "If people than need to do a little bit of statics afterwards than that tends to be down to that individual." – (Coach team II).

During the interviews, there were very few coaches that mentioned any benefits of static stretches at all. All coaches mentioned they would rather see their players stretch in a

dynamic, hockey specific way. Nonetheless, they did leave some space for their players to do any static stretches if they opted to do so themselves. However, from the observations it seems that 77% of all teams use static stretches during their warm-up, which directly conflicts with what the coaches mention during their interviews. One important theme that emerged from this question was the fact that while their coach is trying to convince them of the benefits of dynamic stretches, some players still believe in static stretches. Young (2007) also mentions the importance of a player's psychological routine in his recent study on the effects of static stretches on performance. He also highlighted the possible psychological impact of changing an athlete's warm-up routine. If players have a history of using static stretches and strongly believe in the advantages of static stretching, than changing their routine could have a negative psychological impact. Young (2007) however, does not mention any concrete examples of this psychological impact and no other studies describing these negative results have been found. Still, this might be one of the reasons while coaches still allow their players to static stretch.

> "Most of the other guys like to do static stretches and I don't like that. The older guys want to do statics because they've done it all their lives and they think they get injuries if they don't do them. 'I can probably convince 75% of them to not do it, but there is 25% who would rather static stretch and not do any dynamics." – (Coach team IX).

After the dynamic stretches which are seen as an integral element in the warm-up, most coaches do give their players the chance to do some static stretches at the cool down after the match. This is not the topic of the present study and will therefore not further be discussed.

4.9.2 Dynamic stretching

Looking at the dynamic stretching, coaches opinions are clear. The main reason for doing dynamic stretches is that they are the most hockey specific.

> "We try and make all our movements dynamic and try and make them as hockey related and as specific as possible." – (Coach team X).

The dynamic stretches are all executed during the activate and mobilize phase. By making the stretches as hockey specific as possible, the players prepare themselves for the potentiation phase and eventually the match. As the coach of team number II worded it:

> "The important stretching is the dynamic stretching really and the stretching in a manner that is going to benefit the game." – (Coach team II).

From the observations it became clear that all teams use dynamic stretching in their warm-up. This was expected according to the literature, since dynamic stretches are the best stretches to execute during a warm-up, according previous research (Amako et al, 2003; Young, 2007). One other recent study by Fletcher and Monte-Colombo (2010) also showed the detrimental effects of static stretching and the performance enhancing effects of dynamic stretching on short duration, high intensity soccer specific movement skills like a 20 meter maximal sprint and jump height. Sprint times and jump height improved after a dynamic stretching protocol.

Coaches' opinions on the matter of dynamic stretching in interviews seem to correspond with the observations, as opposed to the subject of static stretches where the observations and interviews conflicted with one another.

4.10 Chapter conclusions

This chapter has shown all the emerging themes that came up from both the observations of warm-ups in practice and the interviews that were conducted with the coaches. The seven themes will be used to further analyze and critique the ideal image of a warm-up that was created from the literature. This resultant image will then consist of literature review, observations in practice and the opinion of the coaches, making it a broad view on warm-ups in field hockey as a whole. The researcher has tried to give an objective view on coaches' opinions, even though his personal background may have influenced him in the choice of quotes from the numerous interviews. Conclusions from the results presented in this chapter will be drawn up in the next chapter.

CHAPTER 5: CONCLUSION

5.1 Introduction to the chapter

In this final chapter an overview of the research findings will be given. The purpose of the present study will be addressed, as well as the methodology used. A comparison between research literature in the area and the data collected in practice will be made. At the end of this chapter, directions for future research in this area will be named as well as the implications the present study might have for the field.

5.2 The research goal

The goal of this study was to compare the literature in warm-ups in field hockey and other sports to what is observed in practice within the sport of field hockey. The second research goal is to create an overview of all the factors that impact the design of the warm-up and create a set of guidelines which will help coaches design the perfect warm-up for their athletes.

Information that will be used to reach the research goal, consists of:

- Previous research in multiple sports and then translating this to field hockey.
- Observations of warm-ups in field hockey on Premier Division and National League level.
- Interviews with head coaches or warm-up leaders of participating teams to compile an image of their background knowledge and the choices they made in warm-up design.

5.3 Summary of research findings

The data from practice in the present study and previous research literature in the area shows there are a lot of factors that determine the final decisions when developing a warm-up.

In field hockey this is no different. The research findings show that there are at least seven factors which should be taken into account with regards to warm-up design and activities. These seven factors are:

- Warm-up duration
- Warm-up phases and the value given to each phase
- The athlete's individual influence on his own warm-up
- Mental and physical importance of the warm-up
- Changes in warm-up structure in and off season
- Warm-up structure in case of delay
- Elements of stretching during the warm-up

Data supporting the seven influential factors listed above has been presented in the results and discussion chapter (Chapter 4). The current chapter will draw conclusions upon the findings that have been presented en will further compare these results to what previously has been written in this area.

From the interviews with coaches it can be concluded that experience as a player and as a coach is the main influence when looking at the coaches' background. This has previously been documented by Cushion et al (2003) and Irwin et al (2004) amongst others. In the present study one coach mentioned a coach education course, but most influential aspect in the majority of the coaches' careers were the experiences they gained as a coach, captain or athlete in previous years. Another influence was their occupation or education, which may influence their background knowledge and the choices they make when developing a warm-up for their team. However, the purpose of this study was not to go in depth into coaches' background, but to find the ideal image of a warm-up. Therefore this matter will not be discussed any further in the present study.

When looking at the duration of the warm-ups observed in the present study, the average duration of a warm-up is 35 minutes and 40 seconds (± 4 minutes and 20 seconds). From the interviews with coaches it became clear that participating teams use a timed warm-up which is structured in multiple key phases. This corresponds to the recommendations in previous literature in the area. When comparing the durations observed in practice to the ideal warm-up durations that coaches mentioned in the interview, it can be concluded that there is quite a big gap between the two. Out of the 10 coaches that were interviewed, 8 mentioned a longer warm-up duration than the one witnessed in practice to be ideal. It can be concluded that even though all coaches use timed warm-up routines, they do not conform to this with a great deal of accuracy.

Each warm-up can be divided into three phases: the raise phase, the activate and mobilize phase and the potentiation phase. The duration of the first two phases was 15 minutes on average. This corresponds to previous findings in literature which state that this phase should take between 5 and 20 minutes (Franks, 1983). Coaches tend to disagree about the importance of each phase. This shows that the warm-up phases are quite coach specific.

Data from the literature research, observations and interviews showed that some coaches feel it is important for their athletes to be able to influence their own warm-up in the way they want. In coaches opinions, that way their athletes can tailor the warm-up to their own needs and prepare in the best way possible for the performance they are about to give. During observations it was noticed that most teams used a team warm-up in which there was time available for athletes to do any exercises or stretches in addition to the team warm-up. Six coaches mentioned during the interviews that this was an important consideration for them,

when they design a warm-up routine for their team. The possibility of influencing their own warm-up may lead to certain benefits for these athletes. However, more interviews with players need to demonstrate whether the players themselves also think about individual warm-ups that way.

Coaches tended to disagree on the difference between the mental and physical importance of the warm-up. There were two main approaches to this matter; on one side the group of coaches that saw all physical training during the week as preparation for the match. They saw the warm-up as the final piece of the preparation, in which the physical element was less important than the mental element. The physical training is important throughout the week but in the last half an hour before the game everything should come together in order to deliver a good performance. On the other side of the debate there were the coaches that saw the physical element as more significant. Their arguments were that athletes should be mentally prepared before they start their physical warm-up. According to them, the physical element in the warm-up is more important since the players at this level play hockey long enough to be mentally prepared for the game ahead. Their nerves will not majorly influence them. Averaging out all the scores coaches gave to both aspects, the general figure was that they were both equally important.

When coaches have developed a good warm-up for their team, they tend not to change it very often. Especially during the season, they keep the same warm-up. When asked what factors might contribute to a change of warm-up activities, coaches gave two main reasons: boredom of the players and the results in games. Boredom was mentioned by 4 out of 10 coaches as a factor that influenced their decision making when it came to changing the warm-up activities during the season. Coaches explained that activities would not change majorly,

but some exercises would change slightly with the warm-up still aspiring to the same goal. That way their athletes would get more out of the warm-up instead of just going through the motions. The second reason for changing the warm-up activities would be a number of poor results in consecutive games. Coaches declared they could often foresee how a game would start based on the warm-up. This shows they directly relate the start of the game to the warm-up.

In case of a delay when the warm-up had already started, coaches would either readjust the intensity of the warm-up or stop the warm-up completely and restart it later. Readjustment of the intensity would mainly happen if the warm-up was only briefly delayed. One of the coaches stated that he would rather have no warm-up at all than a warm-up that lasted too long because this might fatigue his players before the start of the match. By lowering the intensity of the warm-up, players would still prepare themselves for the performance that they were about to take place in but would get less fatigued. If the delay was more than 15 minutes coaches would rather stop the whole warm-up and restart it later. If given an exact time of pushback, coaches could reschedule their timeline for the warm-up. That way they could mostly stick to their designed warm-up. During the delay players could either go inside or use passive warm-up techniques to keep themselves warm.

The last of the factors categories in which the coach has to make choices with regards to warm-up design is the stretching component in the warm-up. As mentioned in the literature, coaches should lean towards using more dynamic, sport specific stretches. From the observations it became clear that coaches actually mostly use dynamic stretches. However, 10 out of 13 teams also used some form of static stretches. From previous research in the area it can definitely be concluded that static stretching is detrimental to performance and should

therefore not be an integral element of the warm-up. Coaches are therefore advised not to make their players static stretch before competition.

5.4 Recommendations for further research

One of the questions emerging from this research is, "What's the ideal construction of a warm-up for elite field hockey players?". The findings from the present study have provided coaches with a guideline to construct a good warm-up for their team, but more research on motor performance level is needed to find out what motions would be ideal to perform during the warm-up. Which movements have the best results on mobility, flexibility, strength and endurance?

Furthermore, it would also be of interest to find out whether there is a clear relation between the players' work rate during the warm-up and the first ten minutes of the match, to find out whether the first phase of the match is an extension of the warm-up. This could be examined through observing the teams multiple times in succession to see if intensity, duration and concentration are the same on each occasion and during the warm-up and the match.

Finally, a link between warm-up quality and the number of injuries during the first part of the match and the second part of the match could be examined. Does the warm-up decrease the number of injuries during the first part of the match?

5.5 Chapter conclusion

By comparing the literature in the area to the general consensus in practice an overview of a warm-up in field hockey has been made. This chapter has summarized the findings of the study and has given recommendations for further research. It can be concluded that a lot more research can be done to further improve warm-ups in field hockey.

CHAPTER 6: APPENDICES

6.1 Appendix A: Behaviour Observation form

Pre warm-up:		Hopping	
Take of Jumper / Trou.		**Power training:**	
Chat		Push-ups	
Get ready (shin / stick)		Sumo's	
Other:		Lunges:	
Other:		Other:	
Submax. component:		**Hockey related:**	
Walking		Pass in 2's (3-10m)	
Jogging		Pass in 3's (3-10m)	
Striding		Pass in 4's (3-10m)	
Sprinting		Pass in 2's (10-25m)	
High knees single		Pass in 3's (10-25m)	
High knees double		Pass in 4's (10-25m)	
Heel flicks single		1-on-1 (on goal)	
Heel flicks double		2-on-1 on goal	
Backwards		3-on-2 on goal	
Kick legs in the air		Pass ex. Hit goal (2pass)	
Sideways		Pass ex. Hit goal (>2pass)	
Cross-feet (grapevines)		Mess around, no struc.	
Tap ground on comma.		Possession Game	
Slalom		Practice SC's	
Speed ladder FW		Hitting snake	
Speed ladder BW		Wave on goal	
Speed ladder SW		Other:	
Hurdle hops		**Pre Match:**	
Skipping		Team talk top-D / Yell	
Other:		High fives	
Other:		Take positions	
Static stretches:		Take of cloths	
Upper Body		Motivating cheering	
Lower Body		Do nothing.	
Dynamic stretches:		Other:	
Upper Body		Other:	
Lower Body		Other:	
Jumps			

6.2 Appendix B: Excel sheet for results

Data Observations 'Warm-up in field hockey

Team: **Start time:**

Date: **Finish time:**

Duration:

Number:	Time (min):	Action:
1	00:00-00:30	
2	00:31-01:00	
3	01:01-01:30	
4	01:31-02:00	
5	02:01-02:30	
6	02:31-03:00	
7	03:01-03:30	
8	03:31-04:00	
9	04:01-04:30	
10	04:31-05:00	
11	05:01-05:30	
12	05:31-06:00	
13	06:01-06:30	
14	06:31-07:00	
15	07:01-07:30	
16	07:31-08:00	
17	08:01-08:30	
18	08:31-09:00	
19	09:01-09:30	
20	09:31-10:00	
21	10:01-10:30	
22	10:31-11:00	
23	11:01-11:30	
24	11:31-12:00	
25	12:01-12:30	
26	12:31-13:00	
27	13:01-13:30	
28	13:31-14:00	
29	14:01-14:30	
30	14:31-15:00	
31	15:01-15:30	
32	15:31-16:00	
33	16:01-16:30	
34	16:31-17:00	

The timeline would go up to 60 minutes, but has been left out for the ease of reading.

6.3 Appendix C: Semi-structured interview protocol

Did you select anyone in particular to lead your teams warm up or are you leading it yourself?

Why do you think you should lead it? / Why do you think he is the best one to lead it?

Do you have any background knowledge that may support your choice of warm up activities?

If so, could you tell me a little about that background?

In percentage terms, how would you rate the importance of the physiological aspect of the warm up compared to the psychological aspect?

Do the warm up activities you use change during the season?

What factors may impact on any such changes?

Who is/are the primary decision maker/s when you make a change to the warm up?

How do you adapt the structure of the warm up if and when matches are delayed?

How would you cope in this situation if the team had already started their warm up?

What do you think is the perfect duration for a warm up (physical part + stick and ball)?

Do your players use any forms of stretching during the warm up?

6.4 Appendix D: Consent Form

Dear coach / warm-up leader,

First of all I would like to thank you for taking part in this research project about warm-up routines in the sport of field hockey. By signing this form you show that you have been properly informed about the goal of this research and the statements below and agree to take part in this research project.

- You give permission to the researcher to observe your team during the warm-up and record their behaviors.
- You can ask questions about the design of the study or any relevant subjects.
- Any questions you have already asked have been answered to your satisfaction.
- You understand that you are free to withdraw from the study if you wish. This will not affect your treatment in any way.

Name: _____

Club: _____

Date: _____

Signature: _____

6.5 Appendix E: Information sheet

Dear coach / warm-up leader,

This study is conducted by researchers from the School of Education at the University of Birmingham. The purpose of this study is to investigate the warm-up routines in the sport of field hockey.

We would like to invite you and your team to take part in this study.

If you agree to take part in this study, your team will be observed during the warm-up before a match. Observations will start half an hour before the match and will finish when the match begins. Your athletes will not be distracted in any way during their warm-up. In addition, following the match or at a time of your convenience we would like to interview you, about the choices you have made in the structure and content of the warm-up activities you employ and your specific background in this field. These interviews will take approximately 5 to 15 minutes.

You can choose to withdraw from this study at any time, without having to give an explanation. Doing so will not affect your treatment in any way. Data collected until that point would only be used and stored, if you agreed to this. No individual or team will be identifiable from any write ups or presentations that result from this research and all study data will remain confidential.

If you have any questions regarding this study please feel free to contact us. Thank you in advance for your participation. After participation, you will get a summary of the results of the study.

Eelke ter Avest (0753 890 XXXX)
Matt Bridge, Supervisor (0121 415 XXXX)

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