EFFECT OF ALTERING THE NUMBER OF PLAYERS, THE DIMENSIONS OF THE PLAYING AREA AND THE PLAYING RULES ON THE NUMBER OF SELECTED TECHNICAL SKILLS PERFORMED, POSSESSION CHARACTERISTICS, PHYSIOLOGICAL RESPONSES AND LEVELS OF ENJOYMENT AND PERCEIVED COMPETENCE DURING GAELIC FOOTBALL IN PREPUBESCENT AND ADOLESCENT BOYS

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Submitted for the award of PhD

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Volume 1 of 1

Declaration

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Abstract

Small sided games have been advocated as an alternative to traditional 15-a-side Gaelic football games for children. Three studies were undertaken to compare the number and types of skills performed, possession characteristics (time, number of players and number of skills performed per possession), physiological responses and levels of enjoyment and perceived competence in children between the age of 10 and 14 years during small sided games and 15-a-side games. The first two studies examined the effect of altering the number of players and the dimensions of the playing area. The third study examined the effect of altering the playing rules while keeping the number of players and playing area constant. The number of skills performed was generally higher in the small sided games than the 15-a-side games. With the exception of the 7-a-side vs 15-a-side game there was generally no difference in possession characteristics, physiological responses or levels of enjoyment between small sided games and the 15-a-side game. Playing rules influenced the levels of enjoyment among 10 year old boys during small sided games. Perceived competence was similar in small sided games and 15-a-side games.

Conclusion

Among children between the ages of 10-14 years, small sided Gaelic football games are a viable alternative to traditional 15-a-side games.

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"I am strong when I am on your shoulders

You raise me up to more than I can be"

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Definition of Terms

Total catches	Sum of high, chest and low catches
High catches	Taking possession of the ball in an overhead position with the hands
Chest catches	Taking possession of the ball with hands between head and waist height
Low catches	Taking possession of the ball with hands below waist height
Total passes	Sum of foot and hand passes
Hand passes	Striking the ball with the hand/fist to transfer it to a teammate
Foot passes	Striking the ball with the foot to transfer it to a teammate
Punt kicks	A pressure relieving kick in the general direction of an opponent's goal
Scoring attempts	Attempt to score during play by striking the ball by hand or foot over the crossbar and between the uprights for a point, or below the bar and between the uprights for a goal
Pick-ups	Lifting the ball from the ground by placing the toe of the boot beneath the ball and lifting it into cupped hands to take possession
Blocks	Using both hands to block the ball as an opponent attempts to punt, kick for score or kick pass in play
Interceptions	Deflection of the ball in open play using the foot or hand to prevent an opponent gaining possession
Solo taps	The act of kicking the ball back to the hands to retain possession while solo-running

Solo hops	Hopping the ball to oneself between solo taps during a solo-run
Touches	A single intentional contact with the ball
Team possessions	When two or more touches are performed by one or more players on the same team while retaining possession of the ball
Players per possession	Number of different players who actually play the ball in a team possession
Time per possession	Duration of each team possession
Small sided Games	Games involving a reduced number of players, played on smaller playing areas using normal or modified rules
Enjoyment	A positive affective response to the sport experience that reflects feelings such as pleasure, liking and fun
Perceived competence	An individuals self belief about their ability in a given achievement domain
Peak height velocity	Age of maximum rate of growth in height during adolescence
Biological age	Developmental level of maturity
Chronological age	Age in years based on an individuals date of birth

Chapter I

1. Introduction

Gaelic football is the most popular team sport in Ireland. It is one of the five games organized and promoted by the Gaelic Athletic Association (GAA). Gaelic football can best be described as a hybrid of soccer, rugby, basketball and Australian Rules football, although it predates all of these games. It is a fast, physical contact game played between two teams of 15 players on a rectangular grass surface approximately 137 m long and 82 m wide. The exact positioning of each player may vary depending on the tactics employed. The ball which is similar in size but slightly heavier than that used in soccer can be played over any distance by foot or hand, and can be carried using the accepted solo running technique (1). This involves kicking the ball from foot to hand while moving. Goalposts with a crossbar are located on both end lines.

The primary objective of the team in possession is to create and exploit space in order to score. A team is awarded a point when the ball is kicked or hand-passed between the posts and over the crossbar. A goal is awarded when the ball crosses the end line between the goal posts and under the crossbar. Three points are awarded for a goal. When the opposition has possession, the primary aim is to decrease the time and space available in order to prevent them from scoring and to regain possession of the ball.

In recent years, a greater emphasis has been placed on identifying and cultivating talented Gaelic football players and elite Gaelic football teams at younger ages. This has resulted in the organization of formal competitions for children under the age of 12 years. Many of the competitive fixtures are played on adult size playing fields, using adult rules where the primary focus is on winning. In many instances, current performance or competitive outcome is used as the definitive criteria for team selection. The fact that children can differ significantly in terms of their chronological and biological or developmental age is rarely taken into account when selecting teams. Children who are more physically mature are more likely to be selected in key positions where they tend to have a monopoly of possession. In contrast, other members of the panel are expected to play a limited supporting role during the game. Such practice discourages the ambitions of many children who have equal or greater potential to become excellent players with the onset of maturity. Indeed, early maturation can convey performance related benefits to a child, which are often temporary, and may cease to be an advantage once all children reach maturity (2).

Perception of competence and enjoyment are associated with both continued sport participation and the quality of sport participation in children. Perception of competence is an individual's self belief about their ability in a given achievement domain (3), and enjoyment is defined as a positive affective

response to the sport experience that reflects feelings such as pleasure, liking, and fun (4).

Given the predictive role of enjoyment and competence related beliefs for children's long-term participation in sport, it is not surprising that a large body of research has focused on developing strategies to enhance perceptions of competence and enjoyment in sport (5). Mastery experience such as developing technical or tactical skill plays a major role in developing children's perceptions of competence and enjoyment (6,7,8).

Prior to the introduction of organized underage GAA competitions, children spent considerable time in unstructured activities such as "street games" or "playing on the green". The majority of these "pick-up" games were organized without any adult involvement. It was not uncommon for the children to alter the number and skill level of the players on each team, and to modify the dimensions of the playing area and the playing rules in order to create an enjoyable non-threatening environment where full participation was guaranteed. These unstructured activities were fun, encouraged improvisation, and nurtured the development of sporting expertise.

In recent years, many sporting organizations have formalized and expanded the concept of "street games" involving fewer participants on appropriate sized playing areas to include formal competitions involving structured "small sided-games" where the number of players on each side, the playing rules or playing equipment is modified. These modified small sided

games have the potential to provide children with equal access to meaningful playing time, while offering greater opportunity to develop perceived competence and mastery experiences in relation to technical and tactical skills (9,10,11). Small sided games may also be more physiologically challenging than interval training and exceed match intensity in 15-a-side games (11, 12).

Gaelic football requires a considerable amount of contextual processing. The ability of children to make decisions is constrained by their capacity to process information. The relationship between a player and the situation around him/her is dynamic and ideally skills should emerge in and around the game environment. Small sided games can be designed to facilitate and optimise the skill and decision making process with respect to the changing demands of the game (13-17). In addition, small sided games may also empower players to make contextual decisions under pressure (18 - 24).

The Gaelic Athletic Association (GAA) recently introduced a series of small sided games called “Go Games” for children between the ages of 7-12 years (25). The games were designed to ensure that participants experienced a sense of achievement and enjoyment through involvement. A characteristic feature of the Go Games is that participants get to play for the entire game. Three different Go Games have been developed, and each game utilises modified rules and equipment that is appropriate for each child’s stage of maturation (26).

1.1 Statement of the Problem

Surprisingly, relatively few studies have systematically examined the effect of altering the number of players, the dimensions of the playing area and the playing rules on the number of selected technical skills performed, possession characteristics, physiological responses and level of enjoyment and perceived competence.

1.2 Study Aim

The following series of studies will examine the effect of altering the number of players, the dimensions of the playing area and the playing rules on the number of selected technical skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence in boys between the age of 10 and 14 years.

1.3 Objectives

1. To compare the effects of altering the number of players, the dimensions of the playing area and the playing rules on the mean number of total catches, high catches, chest catches, low catches, total passes, hand passes, foot passes, punt kicks, scoring attempts, pick ups, blocks, total interceptions, solo taps, solo hops and touches

2. To compare the effect of altering the number of players, the dimensions of the playing area and the playing rules on the mean number of skills

performed per possession, the number of players involved in each possession and the time per possession

3. To compare the effect of altering the number of players, the dimensions of the playing area and the playing rules on the heart rate responses and estimated $\dot{V}O_2$

4. To compare the effect of altering the number of players, the dimensions of the playing area and the playing rules on the levels of enjoyment and perceived competence

1.4 Hypotheses

1. The mean number of technical skills performed will be significantly higher in the small-sided games than the 15-a-side games, and there will be no significant difference between the small-sided game formats.

2. The number of skills performed per possession, the number of players involved in each possession and the time per possession will be significantly higher in the small-sided games than the 15-a-side games, and there will be no significant difference between the small-side game formats.

3. The % heart rate max and estimate percent $\dot{V}O_2$ max will be significantly higher in the small-sided games than the 15-a-side games, and there will be no significant difference between the small-sided game formats.

4. The levels of enjoyment and perceived competence will be significantly higher in the small-sided games than the 15-a-side games, and there will be no significant difference between the small-sided game formats.

CHAPTER II

REVIEW OF LITERATURE

2 Introduction

The Gaelic Athletic Association (GAA) is the largest sporting organisation in Ireland with over 500,000 members in 2,500 clubs throughout the country (27). It is an amateur organisation, and was established in 1884 with the aim of promoting the traditional Irish games of hurling, camogie, handball, Gaelic football, rounders and athletics. Ladies Gaelic football is presently the fastest growing sport in Ireland (27). The introduction of the International Rules game played between the Australian National Football League and the GAA reflects the similarities of both games, and has provided members of both codes the opportunity to play at International level. With the exception of a relatively small number of administrative staff and games development officers, the GAA is entirely dependent on voluntary input.

Parish or community based clubs form the basic unit of the GAA, and competitions are organized from underage up to and including senior level. The winners of the county senior club championship contest the provincial, and ultimately the All-Ireland club series. Like any sporting organization there is a hierarchical competitive structure. Top level players are selected to represent their county team. The All-Ireland inter-county football series is the premier football competition and is played between the months of May and September.

It is not uncommon for children to be introduced to formal Gaelic football competitions where the playing surface area, number of players and the rules are similar to those used in senior competitions. Formal competitions tend to be based on age group (chronological) classification in order to reduce potential physical and cognitive variation and promote fair competition. However, grouping by chronological age often fails to take account of the fact that physical and psychological maturation levels can vary dramatically among children of similar age (28, 29).

2.1 Biological vs. Chronological Age

Biological age refers to the developmental level of maturity (30). The biological processes of maturation do not necessarily coincide with chronological age. Children of the same chronological age can differ by several years in their level of biological maturity (28, 29, 31). There are large variations in the occurrence of these biological changes among children. For example, the linear growth spurt in boys may commence between the age of 10.5 and 16 years and end between 13.5 and 17.5 years (32, 33). Peak height velocity (PHV) refers to the age of maximum rate of growth in height and occurs on average at 11.5 years in boys (33). During this growth spurt boys grow 9.5 cm per year on average. However, growth is higher in boys who mature early compared to those who mature late (32, 33).

Many underage team mentors use current performance or competitive outcome as major criteria for team selection. Long term success in sport is dependent on many factors, and it is difficult to predict ultimate performance potential in players at an early age with a high degree of accuracy. Most talent

identification models have low predictive value, and their usefulness and validity are widely questioned (34). They are likely to exclude many, especially late maturing, "talented" children from team selection and support programs which would facilitate their long term development (34).

2.2 Relative Age

Grouping by chronological age is believed to reduce potential physical and cognitive variation, and promote fair competition (35). However, even when groupings are limited to one-year categories, some children can be almost a year older than others in terms of development. The resultant anthropometric, physiological, psychological and intellectual differences between individuals born early and late in the selection year may significantly impact on performance, and has been termed the "relative age effect". (28, 31, 34, 36, 37).

The effect of relative age was first observed in academic performance (38, 39). Children who had a birthday soon after the selection date for entry into school were more likely to score higher in achievement tests than those who had a birthday just before the selection date. The discovery of the relative age effect in youth sport came as the result of an analysis of the birthdays of recreational, competitive and senior ice-hockey players in Canada. Players born in the first 3 months of the annual age grouping were consistently over-represented, compared to players who were born in the later half of the year. Barnsley et al., (40-42) found a positive relationship between the month of birth

and the proportion of players playing in the National Hockey league (NHL). Professional NHL players were twice as likely to have been born in the first half of the calendar year, than in the last quarter. The relative age effect was even stronger in elite youth hockey leagues (41). Almost 70% of 9-10 year olds playing in the youth hockey league were born in the first half of the year, and only 10% had birthdays in the final quarter of the year. Subsequent research has shown that similar birth date distributions also exist in other professional sports, including, baseball (43), ice hockey (44), and soccer (42, 45-47).

In many European countries the percentage of players with birthdays in the first half of the soccer year is approximately 70% (48). Helsen et al., (29, 34) examined the relative age effect among i) professional soccer players playing in the Belgian first division from 1993 to 1996, ii) youth players aged 10-16 years who were selected for the Belgian national youth teams between 1989 and 1995, and iii) players <16 years transferred in 1995 to a Belgian first division youth team by an official youth transfer. Prior to 1997 the selection year in Belgium commenced on the August 1 (month 1) and ended on July 31 (month 12). Expected birth distributions for each group were calculated from the appropriate years of the general Belgian distribution by age groups. Children born between August and October (first quartile of the selection year), beginning in the 6-8 year age group, were more likely to be identified as talented and to be exposed to higher amounts of coaching. These players were also more likely to be transferred to top club teams, to be selected and play for

national teams and to become involved professionally. In contrast, players born later in the selection year tended to drop out as early as 12 years of age.

In 1997 the eligibility year in Belgium changed from August 1 to July 31, to January 1 - December 31 in accordance with guidelines set out by the Federation of International Football Association. The new starting date provided an ideal opportunity to assess the effect of changes in selection year on soccer success. Not surprisingly, children born in the first quarter of the new eligibility year were more likely to be selected for underage national teams and professional academies than players born later in the year. In contrast, prior to 1997 when the beginning of the competitive season was August, children born in the first quartile of the season (August - October) were more likely to be selected on representative teams and club academies.

A number of explanations have been proposed to explain why children born early in the selection period are more likely to be identified as being more talented than children born late in the year. During puberty and adolescents there is considerable variation in the growth and biological maturity of individuals of the same chronological age (32). A one year chronological age difference between the youngest and the oldest player can result in significant differences in physical, emotional and intellectual development (31, 34, 49). In any single age group within the general population of young boys it is common to find children at varying levels of maturity represented, i.e., advanced (early), average (on time) and delayed (late).

2.3 Maturation Rates

Children who are taller and have a higher level of aerobic power, muscular strength, endurance and speed are often identified as having the most potential and in formal league competition are more likely to be selected over their less developed peers (29, 34, 50-52). In many instances the performance advantages related to early maturation are transient, and most likely will cease to be of significance when all children reach maturity (31). Late maturing children may not only catch up on their early maturing peers in terms of physiological development, but may even surpass them in terms of physical performance (31).

Children who may have greater potential than their more developed peers, are often deprived of playing time, and may even be denied expert coaching by virtue of their exclusion from selection on underage teams (35). Consequently, the less mature child is unlikely to accrue the same playing time or coaching attention which may be detrimental to their long term development and playing prospects (53, 54). Differences in stature between players on the same underage team may be so great that taking part in physical challenges may have a psychological impact whereby the smaller less developed child may loose confidence, or have a decrease in desire or commitment to continue playing the game (34). Late maturing players may also be disadvantaged in terms of psychological maturation. It is likely that older more mature players in any age group may experience greater initial success

than younger less mature players because of physical and psychological advantages (34). These individuals will be encouraged and intrinsically motivated to continue participation. In contrast, a large number of children who are deprived of the opportunity to play on a regular basis but who may have greater potential to become an elite player, can be discouraged, and are more likely to drop-out of the sport (34). It is also possible that children who are selected for competitive teams become known to team officials, and thus are likely to be considered in the future. In contrast, young players who are not initially selected for competitive teams might become discouraged enough to drop out of sport (35).

2.4 Small Sided Games

Various formats of modified games have been adopted for different age groups in a number of sports to facilitate the developmental abilities of the participants. Games can be modified by manipulating the duration, the number of players on each team, the dimensions of the playing area, scoring zones and playing rules (55). In addition, equipment such as the width and height of goalposts, balls, bats, etc., can also be modified. Modified games have been implemented in soft-ball (T-ball), Australian football (freeball), netball (korfbal), field hockey (minkey), basketball (mini-ball), soccer, and more recently Gaelic games (Go Games).

It is claimed that small sided games promote the concept of full participation, provide frequent opportunities for success, encourage players to

work within a team to improve individual technique and team performance skills, and provide an enjoyable non-threatening environment for participation in underage sport (13-16). Sport programs which focus on deliberate play activities involving appropriately structured modified small sided games can also provide young players with the opportunity to develop decision-making and problem solving skills while promoting feelings of competence in children (56, 57). Players develop their technical and tactical skills under similar conditions to those encountered during an official adult game. The game specificity associated with modified games may also simulate the movement patterns and physiological demands of the game, and increase the likelihood of transfer to the competitive environment (58). Surprisingly, relatively few studies have systematically examined the effect of modified small sided games compared with an official full sided game, on technical requirements, physiological responses and level of enjoyment and perceived competence (13, 14, 59).

2.5 Small Sided Games - Technical Requirements

In one of the first studies to examine the technical requirements of small sided games, Grant, et al., (13) compared the number of selected match activities during a standard 11 v 11 soccer game and 8 v 8 games in 11-12 year old soccer players. The playing area was 60 yards x 100 yards and 45 yards x 75 yards for the 11-a-side and 8-a-side games respectively. Game activities performed with the ball were classified as heading, tackling, dribbling, passing,

twisting/turning, turnovers, goal attempts and crosses. A pass that travelled ≤ 20 metres was classified as a short distance pass, 20-40 metres a medium pass, and > 40 metres a long distance pass. The number of tackles, and twists/turns per player was numerically higher in the 8-a-side than the 11-a-side game (figure 2.1). It is not possible to determine if these numerical differences are significant due to the fact that the data was descriptive in nature and the mean differences between the experimental conditions was not statistically evaluated.

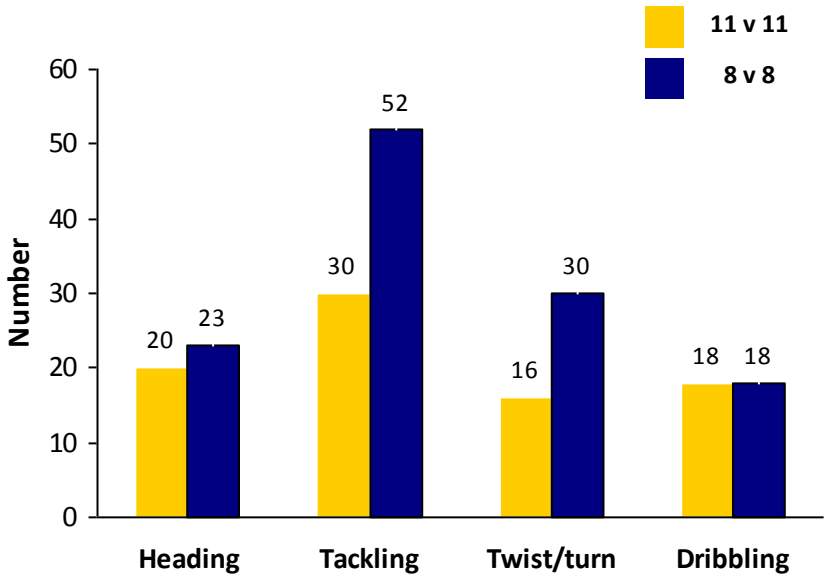


Figure 2.1: Selected match activities performed with the ball during 8 v 8 and 11 v 11 soccer games. (Adapted from Grant et al., Insight 3(2), 1999a)

There were a higher number of passes, goal attempts and crosses, and a lower number of turnovers in the 8 v 8 than the 11 v 11 game formats (figure 2.2). A higher number of technical activities were undertaken during the 8-a-side game even though the surface area available to each player was 23% less than during the 11-a-side game (211 m^2 vs. 273 m^2). The results suggest that

player involvement as measured by the technical skills performed by the children may be enhanced to a greater extent by the number of players on a team than by the field dimensions.

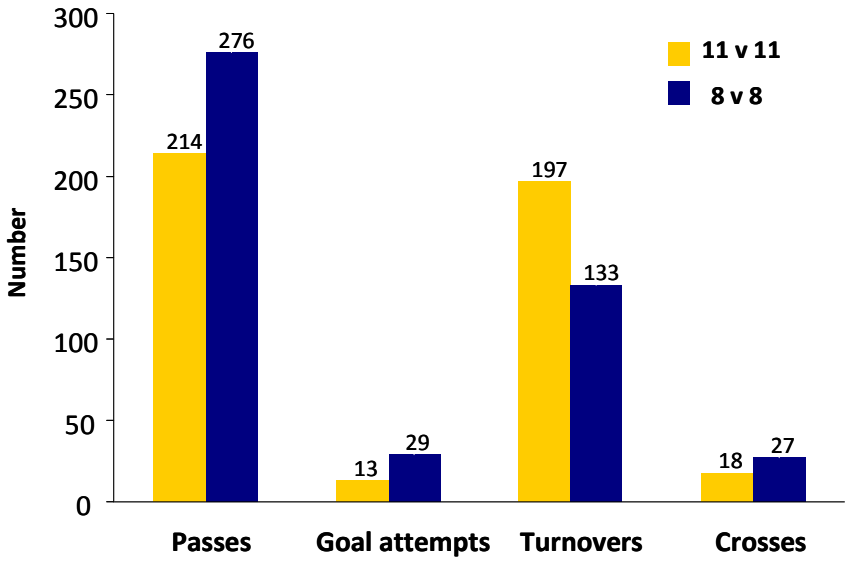


Figure 2.2 Number of passes, goal attempts, turnovers and crosses performed during 8 v 8 and 11 v 11 soccer games. (Adapted from Grant et al., Insight 3(2), 1999a)

Using a similar study design, Grant et al., (14) compared game activities and time motion characteristics during a 7 v 7 and an 11 v 11 soccer game in children between the ages of 9-10 years. The playing area was 40 yards x 60 yards and 60 yards x 100 yards for the 7-a-side and 11-a-side game respectively. The goalposts for the 7 v 7 game were 1.83 metres high and the goal line 3.66 metres wide. Standard goalposts were used in the 11-a-side game. The offside rule was only applied to the 11-a-side game. The results for both game formats were reported as average scores based on 20 minute periods of match play.

The average number of passes was similar in the two match formats (figure 2.3). There were a higher number of short passes and fewer long passes in the 7 v 7 than the 11 v 11 game. There were also a higher number of successful passes and a lower scoring ratio in the 7-a-side than the 11-a-side game (61% vs. 47%).

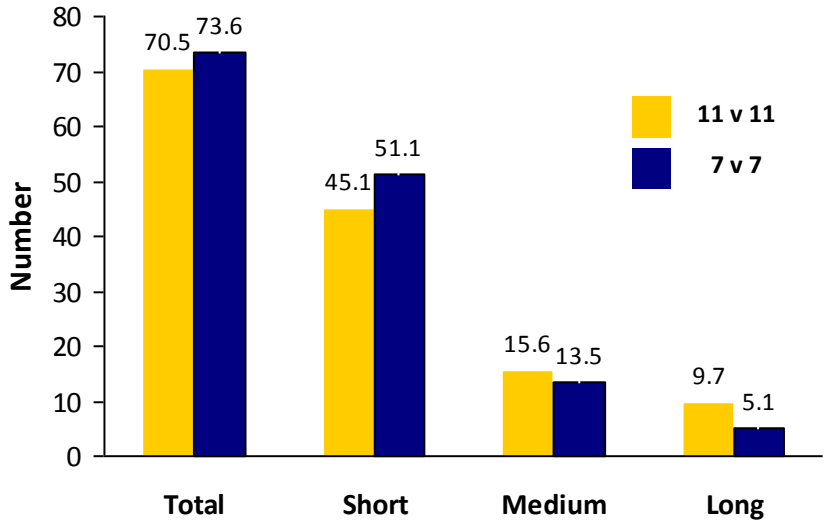


Figure 2.3 Number of passes performed during 7 v 7 and 11 v 11 soccer games (Adapted from Grant et al., Insight 4 (3), 1999b)

Players had more scoring attempts, performed more technical skills, and had a higher percentage of successful technical skills during the 7-a-side than the 11-a-side game (figure 2.4).

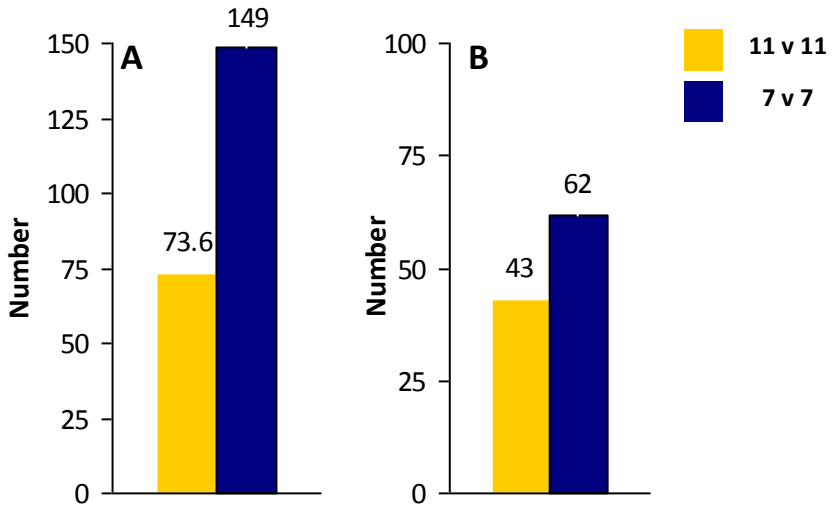


Figure 2.4 Number of technical skills (A) and percentage of successful technical skills (B) performed during a 7 v 7 and the 11 v 11 soccer game format. (Adapted from Grant et al., Insight 4 (3), 1999b)

Capranica et al., (59) compared the number of passes and tackles, during an official 11-a-side soccer game on a regular size playing area (100 metres x 65 metres) and a 7-a-side game on a smaller pitch (60 metres x 40 metres) in 11 year olds. There were a greater number of passes and fewer tackles in the 7-a-side than the 11-a-side game.

It is not uncommon for small sided soccer games to involve teams with < 6 players. Platt et al., (15) compared game activities during, 3 v 3 and 5 v 5 games in young soccer players between the ages of 10-12 years. The playing area was 30 yards x 20 yards and 40 yards x 30 yards for the 3-a-side and 5-a-side games respectively. The data was not statistically evaluated. The number of scoring attempts, dribbles, short and medium passes, forward passes and

successful passes was higher in the 3-a-side than the 5-a-side game. There were also a lower number of turnovers in the 3 v 3 game format. The higher number of ball contacts per player and the higher number of successful outcomes indicate that 3 v 3 soccer games may be more appropriate than 5 v 5 soccer games for developing technical skills. In addition, the physiological demands, assessed by heart rate were higher in the 3-a-side than the 5-a-side games despite 17% less space available to players in the 3 v 3 game. This indicates that it was the greater interaction that influenced the physiological and technical components rather than pitch size.

Modified games have been shown to positively influence technical actions in players as young as 7 years. Jones and Drust (60) compared the technical requirements of a 4 v 4 and 8 v 8 game in 8 male FA Premier League Academy soccer players with a mean age of 7 years. The 4 v 4 game was played on a playing surface 30 metres x 25 metres (94 m^2/player) and the 8 v 8 game was played on a playing surface 60 metres x 40 metres (150 m^2/player). Each game was 10 minutes in duration, and was played under normal match play rules in an indoor facility. The total number of ball contacts per player was 2.8 times greater in the 4 v 4 than the 8 v 8 game. These results indicate reduced player numbers in small sided games provide more opportunities for skill performance and player involvement.

Kelly and Drust 2009, (61) examined the effect of altering the field dimensions on game activities during 5-a-side soccer games. Elite 18 year old

soccer players played three 5 v 5 games on playing areas that measured, 30 metres x 20 metres, 40 metres x 30 metres and 50 metres x 40 metres. Each game was 24 minutes in duration and consisted of 4 bouts of 4 minutes duration, separated by 2 minutes of active recovery. A number of balls were placed around the perimeter to ensure quick replacement. Game activities performed with the ball were classified as passing, receiving, turning, heading, tackling, dribbling, shooting, target pass, and interceptions. There was no significant difference in the number of passes, turns, dribbles, interceptions or headers between the 3 game formats when the frequency of actions across the entire game period were analyzed. These findings agree with Platt et al., (12) who found that the dimensions of the playing area were not as important as the number of players involved.

Katis and Eleftherios (62) examined the technical actions during 3 v 3 and 6 v 6 soccer games in children with an average age of 13 years. The playing area was 15 yards x 25 yards and 30 yards x 40 yards for the 3-a-side and 6-a-side games respectively. Technical actions were classified as short passes (< 10 metres), long passes (> 10 metres), dribbling, shooting, heading and tackling. Despite the fact that the space available to each player was greater in the 6-a-side than the 3-a-side game, the number of short passes, tackles, dribbles and goals scored were significantly higher in the 3 v 3 than the 6-v 6 game. In contrast, the total number of long passes and headers was significantly higher

in the 6 v 6 than the 3 v 3 game. These results suggest that the number of players can influence the type of skills performed during small sided games.

2.6 Summary

To date only three studies, all involving soccer have compared the number of technical skills during a small sided game with an official 11-a-side game. In general there was a higher number of technical skills performed during the small sided than the adult format games. However, the playing area available to each player during the small sided game was arbitrarily selected and differed greatly to the playing area available to each player during the official 11-a-side game. Furthermore, no previous studies have examined the mean number of skills performed per possession, the number of players involved in each possession or the time per possession.

2.7 Small Sided Games - Physiological Responses

The physical demands and physiological stress imposed during match-play are influenced by factors such as physical maturity, exercise intensity, environmental conditions, technical ability, number of players, playing area, game duration, presence of goalkeepers, rules of the games, and the use of encouragement and feedback (11, 63). Time motion analysis is commonly used to quantify the physical demands of individual players during match-play (12, 64, 65). Furthermore, the development of low-cost telemetry systems has led to the wide-spread use of heart rate as an accurate means of assessing and

monitoring the physiological responses during team sports involving intermittent activity (66).

A relatively small number of studies have examined time motion characteristics and heart rate response during regular and small sided games in children and adolescents (55, 67). Castagna et al., (67) evaluated the activity profile in 12 year old soccer players, during 11-a-side games that were 60 minutes in duration. The games were played on a regular size field measuring 100 metres x 65 metres. The mean distance covered during match play was 6,175 metres. The majority of activity involved walking (1,114 ± 102 metres) and low intensity runs (3,200 ± 354 metres). Running velocities > 18 km h^{-1} were classified as maximal runs. Players performed an average of 33 maximal runs of 2.6 sec duration during a game. The average interval between 2 bouts of maximal sprinting was 119 seconds and the total distance covered at velocities > 18 km h^{-1} was 114 metres**.**

Hill-Hass et al., (55) recently examined the effect of altering the player number on the time motion characteristics, ratings of perceived exertion, and physiological responses, during a number of small sided game formats in 16 year old male soccer players. The number of players per team was 2, 4 or 6, and the surface area available was 150 m^2/player during each game format. The games were 24 minutes in duration and there was no offside or restriction on the number of touches on the ball. All players on the offensive team were required to be in the attacking half of the grid for a goal to be allowed. Mini-

goals were used and the coach was allowed to give encouragement and feedback. Four velocity zones were selected for analysis - Zone 1 - standing and walking (0-6 $km \cdot h^{-}$), zone 2 - jogging (7-12.9 $km \cdot h^{-1}$), zone 3 - cruising (13-17.9 $km \cdot h^{-1}$) and zone 4 -sprinting (>18.0 $km \cdot h^{-1}$).

The total distance covered, or the distance travelled while cruising or sprinting did not differ significantly between any of the game formats. The majority of activity in the 3 game formats involved standing and/or walking. The maximal sprint duration and distance covered were significantly lower in the 2 v 2 than the 4 v 4 and 6 v 6 games. In addition, the time between sprints was longer in the 2 v 2 game than the other two formats.

The rating of perceived exertion (RPE), percentage of maximal heart rate (%HRmax) and blood lactate levels were significantly higher during the 2 v 2 than the other two game formats. Interestingly, the increase in physiological and perceptual responses occurred despite the fact that players completed less movement at various running velocities in the 2 v 2 than the 4 v 4 and 6 v 6 games. These results indicate that as player numbers decrease and relative pitch size remains constant, overall physiological and perceptual workload increases. Contrastingly, the mean and maximal duration of each sprint and the distance covered increased significantly as the number of players per team increased. This may indicate that total distance covered is a poor indicator of global work rate, and that the greater involvement with the ball increased the physiological load and rating of perceived exertion.

Billows et al., (68) compared the heart rate responses in 15 year old elite adolescent soccer players during 5 competitive 11-a-side games. The mean heart rate was 88% of maximum heart rate (HRmax) and 85%(HRmax) for the first and second half respectively and 86% (HRmax) for the entire game. Almost 70% of the game time was spent at heart rate >85% HRmax.

Capranica et al., (59), compared heart rate and blood lactate levels in 11 year old soccer players during an official 11-a-side game on a regulation size pitch (100 metres x 65 metres) and a 7-a-side game on a smaller size playing area measuring 60 metres x 40 metres. Heart rate was recorded continuously every 5 sec using telemetry. Fingertip blood samples were taken immediately after the warm-up, and after the first and second half of each game. Individual movements were classified as running forwards and backwards, walking forwards, backwards and sideways, and inactivity. Time spent in each activity, frequency of occurrence of each activity and the duration of running, were recorded. Approximately 38% of the time in both game formats was spent walking, 55% running, 3% jumping and 3% stationary. Running bouts < 10 seconds were 10% more frequent in the 7-a-side game than the 11-a-side game. There was no significant difference in the blood lactate levels or heart rate between the two game formats. This is the only study to compare the physiological responses in children during a small sided soccer game and an official 11-a-side soccer game. The relatively large number of players in the

small sided game may help to explain the fact that there was no difference in the blood lactate levels or heart rate between the two game formats.

Jones and Drust (60) compared the physiological demands during a 4 v 4 and 8 v 8 soccer game in 7 year old boys. Each game was 10 minutes in duration, and was played under normal match play rules in an indoor facility. The total distance covered was significantly greater in the 4 v 4 than the 8 v 8 (778 metres v 693 metres) game despite that fact that the surface area available to each player was 63% higher in the 8 v 8 game. The physiological demands as measured by percent heart rate maximum were 83% in the 4-a-side and 79% in the 8-a-side game.

Castagna et al., (69) reported a mean exercise intensity of 84% HRmax and 75% $\dot{V}O_2$peak during a 30 minute, 5-a-side recreational soccer game in high school students. The games were played on an indoor pitch measuring 30 metres x 15 metres (45m^2/player). Exercise intensity was classified into 3 defined intensity zones: i) low intensity -<70% HRpeak, ii) moderate intensity 70-85% HRpeak, and iii) high intensity >85% HRpeak. Despite the fact that the majority of playing time was spent in moderate (40%) and high intensity (51%) activities, the mean RPE was 4.1 on the Borg 10-points category rating scale (CR-10). This RPE value equated to the verbal descriptor of somewhat hard, suggesting that small sided games may reduce a player's perception of effort.

Platt et al., (15) found no significant difference in the total distance covered during a 3 v 3 and 5 v 5 game in 10-12 year old soccer players. However, the mean heart rate was significantly higher in the 3-a-side game than the 5-a-side game (88% and 82%). These findings indicate that the 3 a-side game imposed a higher physiological demand than the 5-a-side game.

Kelly and Drust (61) examined the effect of altering the dimensions of the playing area on the heart rate response during 5-a-side conditioned games in elite 18 year old soccer players. The pitch dimensions were 30 metres x 20 metres, 40 metres x 30 metres and 50 metres x 40 metres. Each game was 24 minutes in duration and consisted of 4 bouts of 4 minutes duration, separated by 2 minutes of active recovery between exercise bouts. The percentage maximal heart rate ranged from 89% - 91%. Similarly, previous studies have also found that altering the playing area can significantly influence the heart rate response (70).

The intensity level during a game may also be influenced by the technical ability of each player. Games or passages of play involving players with low technical ability may not be as free flowing and therefore may be of lower intensity compared to activities involving players with high levels of technical ability (71). The motivational climate in which a game is played may also influence game intensity (12).

2.8 Oxygen Uptake

The uptake and transport of oxygen is required for the efficient production of ATP to support the metabolic demands of the body during Gaelic football. Both central (oxygen delivery) and peripheral (oxygen extraction) factors determine systemic oxygen transport. Maximal aerobic capacity ($\dot{V}O_2$max) defines the upper limits of the cardiopulmonary system and is a product of maximal cardiac output and maximal arterio-venous oxygen difference. The ability to sustain a high rate of aerobic energy expenditure for a prolonged period of time is a function of $\dot{V}O_2$ max (71, 72).

2.9 Estimating $\dot{V}O_2$ from Heart Rate

It is not possible to measure $\dot{V}O_2$ directly during match play without hindering performance. However, the linear relationship between heart rate and oxygen uptake allows heart rate to be used to estimate oxygen uptake during exercise (73, 74, 75). The linear relationship between heart rate and $\dot{V}O_2$ during incremental exercise can be expressed as a simple linear regression equation; $y = mx + c$ (31, 73). Oxygen uptake (y) is the dependent variable and can be predicted when the heart rate value (x) is known. The terms c and m are the intercept, and slope of the line of best fit, respectively.

Factors such as heat, emotional and psychological stress and static exercises may cause the heart rate to rise independently of $\dot{V}O_2$ during exercise and may alter the linearity of the HR-$\dot{V}O_2$ relationship during match play (76). Heart rate may also be elevated at apparently low work-rates during certain

periods of a match due to the non-orthodox activities involved in match play such as changing direction, getting-up off the ground, backward running, sideward running or isometric muscular actions (77).

Castagna et al., (78) examined the validity of using heart rate to estimate aerobic involvement during a 5-a-side indoor soccer game in moderately trained players and skilled players. Individual HR-$\dot{V}O_2$ relationships were determined from an incremental treadmill exercise test with open circuit spirometry. Expired gases and heart rate were continuously monitored during the 5-a-side game using a portable open circuit spirometry and telemetry analysis system. The average %HRmax and %$\dot{V}O_2$max attained during the 5-a-side game was 72% and 53% respectively. The variance in heart rate explained by $\dot{V}O_2$ during the incremental treadmill test ranged from 89 - 97%, with the mean value of 93%. When averaged across the 10 players approximately 71% of the variance in HR during the 5-a-side game was explained by $\dot{V}O_2$ indicating that the treadmill HR-$\dot{V}O_2$ relationship was able to accurately estimate the physiological load imposed during practice. However, the variance in heart rate explained by $\dot{V}O_2$ during the 5-a-side game ranged from 27% to 85%.

In a follow up study Castagna et al., (69) assessed the validity of the HR-$\dot{V}O_2$ relationship between intermittent and continuous exercise in soccer players with an average age of 17 years. Individual HR-$\dot{V}O_2$ relationships were determined from an incremental treadmill test using a HR telemetry system and a portable open circuit spirometry system respectively. Players were

subsequently fitted with the HR telemetry system and a portable open circuit spirometry system during a 5-a-side indoor soccer game. The games were 12 minutes in duration and were played on an indoor soccer pitch measuring 30 metres x 15 metres. Subjects attained 72% and 52% of HRmax and $\dot{V}O_2$max respectively. However, only 71% of the variance in HR was explained by $\dot{V}O_2$. When averaged across all players on the team there was no difference in directly measured $\dot{V}O_2$ compared to estimated $\dot{V}O_2$. However, there were large estimation errors when the measured $\dot{V}O_2$ value was compared to estimated $\dot{V}O_2$ at an individual level.

The HR-$\dot{V}O_2$ relationship has also been compared during field based soccer-specific exercises designed to replicate the movement patterns and activities commonly performed during soccer training or games (73). Seven male amateur soccer players (age 25.3 ± 1.2 years) performed 3 trials on a purpose designed circuit at intensities perceived to be moderate, high and very high, and an incremental test on a treadmill in a laboratory. Expired respiratory gases and heart rate were continuously measured during both the field and laboratory based tests. There was a positive linear relationship between HR and $\dot{V}O_2$ during both the field and laboratory tests. The mean value of the HR-$\dot{V}O_2$ regression line slope and intercept were similar in the laboratory and field based test indicating that the physiological load can be determined using a laboratory reference test.

2.10 Summary

To date only one study has compared the physiological responses in children during a small sided game (7-a-side) and an official 11-side-game. There were no significant differences in blood lactate levels or heart rate between the game formats. A number of studies involving children have found significant elevations in heart rate during small sided games involving 2 to 8 players. A major limitation of the studies that evaluated the physiological responses during small sided games in children is the fact that the playing area available to each player during the small sided game was arbitrarily selected and did not take account of the surface area available to each player.

2.11 Factors Influencing Sport Participation

2.11.1 Enjoyment

Involvement in team sports activity enhances not only the physical well-being of children (79, 80) , but also contributes to both psychological and social development, by positively influencing perceptions of competence and self-worth (5, 81). A large body of research has explored motivation to exercise among young people in an effort to increase youth participation in physical activity, and to examine the factors that influence exercise involvement and the quality or intensity of activity. Most of the research on motivation and physical activity among youths has been conducted within organised sports settings (82).

Enjoyment and perceived competence in the sports domain can influence continued sport participation and the quality of sport participation (81). Sport enjoyment is defined as a positive affective response to the sport experience that reflects general feelings such as pleasure, liking and fun (4). While sport enjoyment is often used to indicate intrinsic motivation they are not however, synonymous constructs.

Scanlan and Lewthwaite (83) developed a framework to investigate the diverse sources of sport enjoyment that went beyond those which are intrinsic and achievement related. They proposed that sport enjoyment is influenced by both achievement and non-achievement factors, which can be either intrinsic or extrinsic in origin. Achievement factors that are intrinsic in origin relate to perceptions of competence and control that are self-referenced, like feelings of mastery in performing a skill. Achievement factors that are extrinsic relate to feelings of competence and control that are dependent on feedback from other people, such as through positive social recognition. Non-achievement intrinsic factors are those which are related to the experience of the activity, like movement sensations or the thrill of competition. In contrast, non-achievement factors that are extrinsic, relate to non-performance aspects of sport, such as social interactions with peers and significant others. It follows therefore that something can be enjoyable without being intrinsically motivating.

Studies in youth sport repeatedly show that the desire for enjoyment or fun is a major reason given for initial and continued participation in sport . Conversely, lack of enjoyment or fun is cited as the main reason why children withdraw or drop out of sport (4, 8, 84-86). Sport commitment can be defined as a psychological state representing the desire or resolve to continue sport participation (87). The importance of sport enjoyment as a determinant of continued sport participation, is consistent with findings showing that fun and enjoyment in organised youth sport are highly correlated with the desire and resolve to continue participation in sport (88, 89).

The sport commitment model has been proposed as a theoretical framework for examining the motivation underlying continued sport involvement (88). This model proposes that commitment is a function of i) enjoyment, ii) the attractions of involvement alternatives, iii) personal investments in participation, iv) the involvement opportunities afforded by continued participation, and v) social constraints to continue participation. Each of the model's components is considered at the level of individual perceptions and takes into account both cognitive and affective factors in the individual's commitment to continue involvement in sport.

The basic premise of the sport commitment model is that the more an individual enjoys playing a particular sport, the more opportunities they feel involvement offers, the more constrained they feel to continue playing, and the less attractive their alternatives to involvement, the greater their commitment

(88). Not suprisingly, a decrease in sport enjoyment and involvement opportunities is associated with a corresponding decrease in committment (89). Increases in involvement opportunities have been shown to be associated with a corresponding increase in commitment (89).

Weiss et al., (8) used the sport commitment model as the theoretical framework to examine the determinants of junior tennis players' motivation to continue their involvement in the sport. A version of the original sport commitment model (i.e., determinants directly predict commitment) and a revised model where enjoyment was a mediator of the relation between determinants, and a level of commitment were tested. The results provided support for both the original and mediational models, and found sport enjoyment was the strongest predictor of sport committment in both models. Results of this study confirmed enjoyment as a strong influence on commitment, and personal investments and attractive alternatives as significant predictors of tennis enjoyment.

2.11.2 Perceived Competence

Perceptions of competence refers to an individual's beliefs about his/her ability in a given achievement domain (5). In the sport domain, a child's perceptions of competence is linked to motivation outcomes (i.e., persistence, effort and intensity) and emotional responses (i.e. enjoyment). Simons-Morton et al., (90) found that elementary school students who reported higher levels of self efficacy in physical activity (i.e. the belief that one`s skills can achieve a

specific outcome) also indicated a greater time spent in moderate to vigorous and vigorous physical activity. Other studies have reported similair findings with elementary students (80, 91).

Childrens' perceptions of competence can predict their performance and behaviour in sport and other physical activities. Specifically, children who have high perceptions of sport competence are more likely to experience positive affect such as enjoyment, pride, happiness and satisfaction, and are less likely to experience negative affect such as boredom, anxiety and anger, than children with low perception of competence (3, 5). Behaviourally, children with high perceptions of competence are most persistant following the experience of failure at a physical task, and have higher expectations for performance success than do children with low perceptions of competence (92).

Childrens' perceptions of competency change both quantitatively and qualitatively during the childhood and adolescent years. These changes are caused not only by the age-related maturational changes in relation to physical, cognitive and emotional capabilites (7), but also by a response to changes in the sport environment and/or the broader social environment itself (5). As an individual moves from childhood to adolescence the sport environment also undergoes change. In early childhood the sport environment is one in which emphasis is placed on learning fundamental sport skills and where feedback is based on task mastery or finishing a task. In adolescence, the sport

environment changes to one in which children perform in offical leagues, feedback is increasingly based on task quality, performance outcome and peer comparison. Peer comparison and winning assumes much greater importance. This in turn affects the coaches' behaviour and influences the training demands required for success.

Perceived competence is an important factor in determining children's sport enjoyment, participation and commitment (83, 86). Crocker et al., (6) investigated the relationship between self-perceptions and physical activity in Canadian school children and found that self perceptions, physical conditioning and sport skills are significant correlates of activity in this population. The authors suggested that practitioners should strive to enhance perceptions of competence by promoting task mastery of skills and fitness in children aged 10-14 years. These findings were supported by others (93) who also found that task orientation and perceived competence significantly predicted enjoyment.

The achievement goal theory, first advocated by Nicholls (94) provides a framework for understanding the relationship between perceived competence, enjoyment, and goal orientation from a developmental perspective. The theory proposes that there are two basic dispositions that individuals can have to varying degrees in achievement situations, namely task and ego goal orientation. Task orientation defines success in terms of getting better and trying hard, whereas ego orientation defines success in terms of winning and out performing others.

Competence or ability can be construed in different ways (95). Young peoples understanding of effort and ability develops and changes with age. Children under the age of 11 years have an undifferentiated conception of ability. They do not distinguish or differentiate ability from effort, and their perceptions of competence are self-referenced. Players feel competent when personal progress, task mastery or learning have occurred (5, 92, 94-97). They equate outcome with effort resulting in high perceived competence and enjoyment if they try hard. This undifferentiated goal orientation is closely related to task goal orientation where children are motivated by the process of learning and not necessarily the outcome or production.

Children older than 12 years have been shown to be able to distinguish between effort and ability (7, 94, 96, 97). Ability is construed as capacity, and perceptions of competence are referenced to others. The child may feel competent when he/she outperforms others. This differentiated goal orientation is associated with ego goal orientation where the child equates success with winning rather than learning and developement. This ability to differentiate is due to a developmental factor which Nichols (97) referred to as the “mature conception of ability” because it is not present in children who are not cognitively mature enough to differentiate ability from effort. Consequently, goal orientators do not emerge until late childhood at approximately 12 years of age in most children.

2.11.3 Motivation

Cognitive evaluation theory (a theory integrated within the broader self-determination theory) (98, 99) is commonly used to study motivation in educational settings. The fundamental concept underlying the cognitive evaluation theory is that intrinsic motivation is based on peoples needs to be self-determining and competent. Activities that provide opportunities to satisfy the need to feel competent and self-determining will maximise intrinsic motivation. In turn, intrinsically motivated individuals will maximise effort and persistance in optimally challenging activities, and thus experience interest and enjoyment levels that increase or sustain participation.

In addition to sport settings, goal orientations are also helpful in examining the relation between motivated behaviours and their sources in the classroom and educational setting because they faciliate or diminish adoption of a particular achievment goal, self-perception and/or motivation (82). Within the physical education context, a performance climate is promoted by the teacher's emphasis on interpersonal competition, public evaluation and normative feedback. In contrast, a mastery climate is fostered by the teachers focus on learning, self-improvement, and participation behaviours such as optimally challenging tasks and effort. A positive relationship between a mastery climate and intrinsic motivation is consistently shown in the physical education setting (100, 101). Theeboom et al., (102) found teaching styles that promote a mastery climate results in higher levels of enjoyment, perceived

competence, motor skills and intrinsic motivation than did a teaching style consistent with a performance climate.

Ferrer-Caja and Weiss (82) concluded that when high school students perceived that their physical education class promoted learning and particpation (i.e. task orientated) they focused on the activities and evaluated their own success using self-referenced sources, such as effort and improvement. The students also viewed their ability highly and felt they had a choice of what to do in the class. Moreover, they participated in the class for reasons related to enjoyment, fun, and a desire to learn and, in turn choose difficult activities, tried hard and persevered even after failures.

While most of the early motivation studies in sport participation had a descriptive and a theoretical basis, recent studies have employed a more theoretical application (102). Harter's (103) competence motivation theory and Nicholls' (97) achievement goal theory, both developed in the academic domain are increasingly influencing the thinking of those researchers involved in the area of motivation and perception of competence with children playing sport. According to Harter (103) young people who perceive themselves high in competence and internal control in an achievement domain such as a classroom or sports arena will be more intrinsically motivated to remain involved and to work hard to improve and learn, and will experience more positive affect than children with lower levels on these characteristics.

Nicholls (97) suggests that young people are motivated to demonstrate high ability and that they may conceive their ability or competence on the basis of ego goal orieantation or task goal orientation. For some individuals, success is evaluated through norm-referenced methods (eg., social comparison), i.e., ego goal orientation. Others may consider ability or competence on the basis of self-referenced goals (eg., personal improvement) i.e., task goal orientation.

2.11.4 Summary

There is a substantial body of evidence indicating the importance of creating an environment that is task or mastery orientated and emphasises effort, learning and self improvement with children involved in sport. Not every child can be above average in athletic or sport ability, yet all can be high in levels of task orientation, a construct that is highly influenced by the social climate or structure in which sport is experienced (104). It is important when working with children that coaches structure the sport environment appropriately so as to encourage task mastery, learning, effort and personal progress and not over emphasise performance outcome. This will ensure that children develop their perceptions of competence and enjoy the experience of particpation, thus increasing their commitment to continued involvement.

This research project explores the possibilities provided by small sided games to create a more appropriate environment than the official fifteen a side league competition for children to learn and enjoy playing Gaelic games specifically Gaelic football.

CHAPTER III

RESEARCH STUDY 1

Physiological Responses, Skill Performance, Possession Characteristics and Enjoyment and Perceived Competence in Children during a 7-a-side and a 15 a-side Gaelic Football Game

3 Rationale

The constant pressure to identify and cultivate talented players and elite Gaelic football teams at younger ages has resulted in the introduction of formal competition for children as young as 10 years. In many instances the number of players on each team and the playing rules during games involving children are similar to those used in adult competitions. Teams tend to be based on chronological age, and fail to take account of biological age (29, 35, 38, 40-42). It is well documented that physical and psychological maturation levels can vary dramatically among children of similar age (2, 28, 31-33, 36, 105). Indeed, what many coaches perceive to be precocious talent is in many instances the advantages afforded by early maturation.

Current performance level or competitive outcome, are often used as the definitive criteria for team selection. Selection procedures appear to be biased in favour of physical size and strength. Such practice discourages the ambitions of children who have equal or even greater potential to become excellent players at maturity.

There is a need to employ a multifaceted approach to underage competitions during the developmental years. This approach should be based on the premise that all children are provided equal access and meaningful playing time in a fun-filled environment, where winning is one of the goals but not the single overriding objective, and where the children's development, confidence and enjoyment are also intrinsic factors in the overall scheme of things. Small sided soccer games played on appropriate sized playing areas have been advocated as an affective alternative to the current system in soccer research (13, 14, 59).

3.1 Aim - Study 1A

To evaluate the effect of altering the number of players and the dimensions of the playing area on the number of selected technical skills performed, possession characteristics, and levels of enjoyment and perceived competence in 14 year old boys.

3.1.1 Specific Aims

1. To compare the number of technical skills performed during a 7-a-side game and a 15-a-side game where the playing surface area available to each player is kept constant

2. To compare the possession characteristics during a 7-a-side game (small sided game) and a 15-a-side game where the playing surface area available to each player is kept constant

3. To compare the levels of enjoyment and perceived competence during a 7-a-side game and a 15-a-side game where the playing surface area available to each player is kept constant

3.1.2 Hypotheses

1. The number of technical skills performed will be significantly higher in the 7-a-side game than the 15-a-side game

2. The possession characteristics will not be significantly different between the 7-a-side game and a 15-a-side game

3. The levels of enjoyment and perceived competence will be significantly higher in the 7-a-side game than the 15-a-side game

3.2 Aim -Study 1B

To evaluate the effect of altering the dimensions of the playing area on the number of selected technical skills performed, physiological responses, and levels of enjoyment and perceived competence during a 7-a-side game and the same 7 players during a 15-a-side game

3.2.1 Specific Aims

1. To compare the number of technical skills performed during a 7-a-side game and the same 7 players during a 15-a-side game where the playing surface area available to each player is kept constant

2. To compare the heart rate responses and estimated $\dot{V}O_2$ during a 7-a-side game and the same 7 players during a 15-a-side game where the playing surface area available to each player is kept constant

3. To compare the levels of enjoyment and perceived competence during a 7-a-side game and the same 7 players during a 15-a-side game where the playing surface area available to each player is kept constant

3.2.2 Hypotheses

1. The number of technical skills performed will be significantly higher in the 7-a-side game than the 15-a-side game

2. The heart rate responses and estimated $\dot{V}O_2$ will be significantly higher in the 7-a-side game than the 15-a-side game

3. The levels of enjoyment and perceived competence will be significantly higher in the 7-a-side game than the 15-a-side game

3.3 Subjects

Members of two under-14 Gaelic football club teams volunteered to participate in the study. Each player had a minimum of 2 years playing experience. During the season they trained on average 2 days per week and played a game on most weekends during the competitive season. The nature and risks of the study were explained to each child and his parents and/or guardians. Parents completed a health questionnaire to assess whether their child has any contraindications to participating in the study. Written informed

consent and assent were obtained from the parents/guardians and children respectively (Appendix 2). The study was approved by the Research Ethics Committee at Dublin City University.

3.4 Overview of Study Design

The study design is outlined in figure 3.1 and involved a 15-a-side game and a 7-a-side game. The games were played under normal GAA rules and were videotaped for subsequent analysis of selected technical skills and possession characteristics.

The study design allowed the comparison of a number of selected technical skills performed, possession characteristics, and levels of enjoyment and perceived competence between a 15-a-side game and a 7-a-side game (figure 3.1A) and the number of selected technical skills performed, physiological responses and levels of enjoyment and perceived competence between a 7-a-side game and the same 7 players during a 15-a-side game (figure 3.1 B).

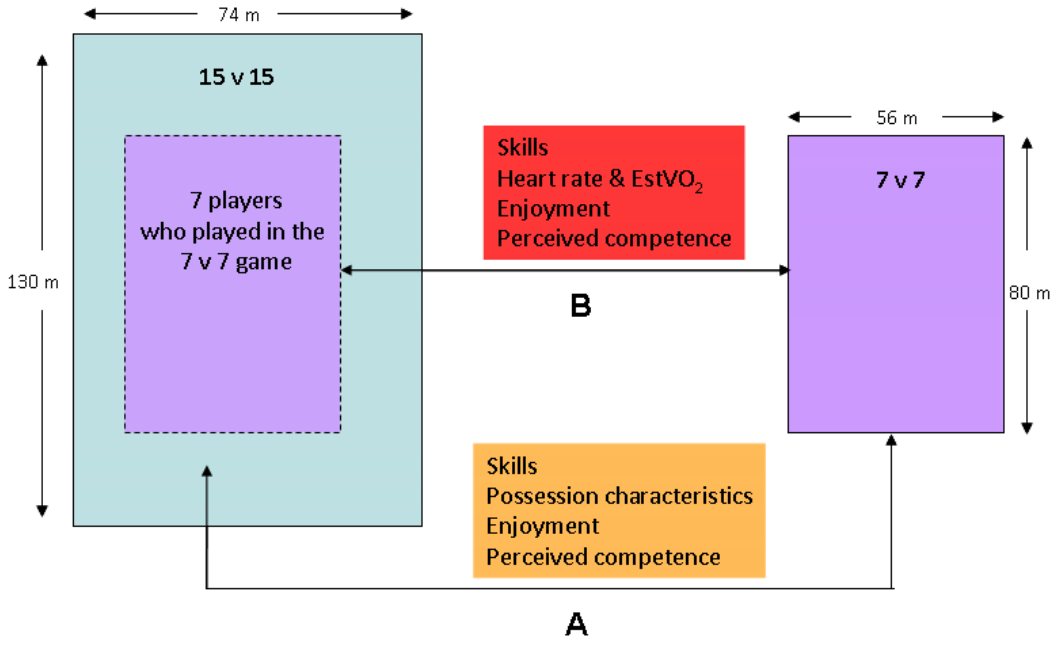


Figure 3.1 Schematic of Study 1A and 1B – Research design

The 15-a-side game was an official division 1 league fixture played on a field measuring 130 metres x 74 metres and consisting of two 30 minute periods, with a 10 minute interval between periods. Only one of the teams participated in first element of the study. Six outfield players from this team were randomly selected, and along with the goalkeeper wore a heart rate monitor (Polar Precision Performance SW 3.0, Kempele, Finland) during the game. Following the game all 15 players on the team participating in the study completed a questionnaire (appendix 1) to assess their levels of enjoyment and perceived competence. Selected technical skills and possession characteristics were also analyzed.

The second game was a specially organized 7-a-side game involving the goalkeeper and 6 outfield players who wore the heart rate monitors during the

first 15-a-side game, and 7 players from a local team that played in the same county league. The heart rate monitors were again worn by the same 6 outfield players and the goalkeeper. The game was 30 minutes in duration and consisted of two 15 minute periods. The half-time interval was <2 minutes in duration, during which time the teams changed the goals that they were attacking and defending. To ensure that the surface area per player was identical to the 15-a-side game (320 m^2/player), the field dimensions were altered to measure 80 metres x 56 metres (Figure 3.1). Following the game the 7 players who wore the heart rate monitors completed a questionnaire to assess their levels of enjoyment and perceived competence. Selected technical skills were also analyzed.

The 7 players who wore heart rate monitors during both the 7-a-side and 15-a-side game made a single visit to the Human Performance Laboratory at Dublin City University (DCU) in order to assess their anthropometric characteristics, lung capacity and maximal aerobic capacity ($\dot{V}O_2max$).

3.5 Methods

3.5.1 Anthropometrics

Height was measured to the nearest 0.1 cm using a portable scales (Seca 707 Balance Scales, GmbH, Hamburg, Germany). Participants removed their shoes and stood with their feet together on the base plate with their arms loosely by their side. Each participant was asked to take a deep breath and to stand with their back as straight as possible against the vertical measuring rods and to look straight ahead. Body mass was measured to the nearest 0.1 kg (Seca model 220 GmbH, Hamburg, Germany). Participants were instructed to wear a light top and shorts and to remove their shoes prior to the measurement.

Lang skinfold callipers (Cambridge Scientific Industries, MD) were used to measure double thickness subcutaneous triceps and subscapular adipose tissue. Measurements were taken on the right side of the body. Percent body fat was calculated using the equation $(1.21(\sum SF) - 0.008(\sum SF)^2 - 3.4)$ developed by Slaughter et al (106) for children and youth .

3.5.2 Pulmonary Function Assessment

Forced expiratory volume in one second (FEV_1), and forced vital capacity (FVC), were determined using spirometry (Sensormedics Vmax 229, Yorba Linda, CA, USA). A mass flow sensor coupled to a disposable mouthpiece was used to

collect measurements of ventilation. The mass flow sensor was calibrated prior to each test using a 3 litre volume syringe (Sensormedics, Yorba Linda, CA, USA).

3.5.3 Cardiorespiratory and Metabolic Measurements

Expired gases and ventilatory volume were determined using a Sensormedics Vmax 229 metabolic system (Sensormedics, Yorba Linda, CA, USA). The gas analyzers were calibrated prior to testing with standard gases of known concentration. A mass flow sensor was used to collect breath-by-breath measurements of ventilation. The mass flow sensor was calibrated prior to each test using a 3 litre volume syringe.

Maximal aerobic capacity ($\dot{V}O_2$ max) was assessed on a treadmill (Woodway ELG 55) using a ramp protocol. Following a 2.0 minute warm up at 134 $m \cdot min^{-1}$, the gradient was increased 0.2% every 12 seconds until the subject reached volitional exhaustion. Breath by breath expired oxygen, carbon dioxide, ventilatory volume and respiratory exchange ratios were determined using open circuit spirometry (Sensormedics Vmax 229 metabolic system, SensorMedics Corp., Yorba Linda CA). $\dot{V}O_2$ max was determined by averaging the 2 highest consecutive 30 second values.

Heart rate was continuously measured with a sampling frequency of 5 second using a wireless Polar team system (Polar Precision Performance SW 3.0, Kempele, Finland). Each heart beat was recorded and stored on a receiver that was attached to an elastic strap and placed around the chest. The heart rate data was subsequently transferred from the receiver to a PC for analysis.

Oxygen uptake during each game was estimated for each subject using the individual linear regression equation between $\dot{V}O_2$ and HR obtained during the progressive treadmill test.

3.5.4 Levels of Enjoyment and Perceived Competence

The 4-item subscale of the Sport Commitment Model (87) designed for the youth sport domain, with items from the subscale adapted for Gaelic Games was used to measure enjoyment (appendix 1). These items have been validated in a sample of children, with a mean age of 13.6 years, from a wide range of sports, and has an internal reliability of α 0.90 (89). Items from the subscale were adapted for Gaelic football. The items were rated on a five-item Likert scale from 1 'not at all' to 5 'very much'. Items included, Did you enjoy playing Gaelic football in this game? (1) not at all, (5) very much. Were you happy playing Gaelic football in this game? (1) not at all, (5) very much. These items have shown to demonstrate adequate internal reliability (107).

A series of questions based on the work of Eccles et al., (108) were included to assess perception of ability. These items were rated on a seven-item Likert scale from 1 'not at all good' to 7 'very good'. Questions included "How good in Gaelic football are you? (1) not at all good, (7) very good "If you were to list all the players on your team from the worst to the best, where would you put yourself ? (1) one of the worst (7), one of the best. Past research has demonstrated adequate psychometric properties for this scale (108, 109).

Children were requested not to sign their names to the questionnaires to ensure maximum confidentiality. The questionnaires were coded to link each child's physical performance and psychological data. Participants were assured that all responses were confidential and were encouraged to ask questions to clarify any misunderstanding. They were also reminded after each game to relate their responses to the game that they had just played.

3.5.5 Video Analysis

Video footage was recorded from a camera (JVC PRO HD, London, England) that was mounted on a tripod on a purpose built elevated platform. The video footage from each game was downloaded as avi. files and stored on a La Cie Big Disk 500GB hard drive. Footage was analyzed using the Focus X2 version 1.4 system on a Latitude D800 Dell laptop computer (Dell, Dublin, Ireland). Focus X2 version 1.4 software notational analysis system (Elite Sports Analysis Limited, Scotland) was used to generate accurate and objective statistical information through a process of systematic observation. This software system combines video and statistical analysis into a software tool. The category design tool was used to create a category set appropriate to record information on selected skills. The following skills were analyzed; total catches, high catches, chest catches, low catches, total passes, hand passes, foot passes, punt kicks, scoring attempts, pick-ups, blocks, interceptions, solo taps, solo hops, and touches.

In addition, the number of possessions, time per possession and the number of players involved in each possession and the number of skills in each possession were analyzed. To avoid inter observer bias the match analysis was performed by a single observer. The games were scored on two separate occasions by the same observer. The intraclass correlation coefficient was 0.99 indicating an excellent test-retest reliability.

3.5.6 Statistical Analysis

Data was compared between the total 30 minutes of the 7-a-side game, and the first half (30 minutes) of the 15-a-side games. A Mann-Whitney test was used to compare mean differences in selected technical skills, possession characteristics, and enjoyment and perceived competence levels between the 7-a-side game and the 15 a-side game. The Wilcoxan Signed Ranks was used to compare mean differences in selected skills, possession characteristics, physiological responses, and enjoyment and perceived competence levels during the 7 a-side game and the same 7 players during a 15 a-side game. A probability of $p \leq 0.05$ was accepted for statistical significance. Data were analyzed using SPSS (v17.0, SPSS Inc., IL).

3.6 Results

3.6.1 Study 1A: 15-a-side Game v 7-a-side Game

The first comparison is between the number of selected technical skills performed, possession characteristics and levels of enjoyment and perceived competence during the 15-a-side game and the 7-a-side game. The playing area available to each player was identical in each game (320 m^2).

The skills performed during the 15-a-side game and the 7-a-side game are outlined in table 3.1. There was no significant difference in the mean number of punt kicks, low catches and blocks between the two games. The mean number of total catches, high catches, chest catches, total passes, hand passes, foot passes, scoring attempts, pick-ups, blocks, interceptions, solo-taps, solo hops and touches was significantly higher in the 7-a-side game than the 15-a-side game.

The possession characteristics during the 15-a-side game and the 7-a-side game are outlined in table 3.2. There were 40 and 41 team possessions during the 15-a-side game and 7-a-side game respectively. There was no significant difference in the mean number of skills per possession, the number of players involved in each possession, or the time per possession between the 7-a-side and 15-a-side game.

Enjoyment levels were significantly higher ($p<0.01$) during the 7-a-side game than the 15-a-side game (Table 3.). There was no significant difference in perceived competence between the two games.

Table 3.1 Selected technical skills performed during the 15-a-side game and the 7-a-side game

	Game	
	15 v 15	**7 v 7**
Total catches	5.8 ± 4.3 (81)	9.7 ± 3.8* (58)
High catches	0.4 ± 0.6 (6)	0.8 ± 0.4* (5)
Chest catches	3.1 ± 2.6 (44)	5.5 ± 2.9* (32)
Low catches	2.2 ± 1.8 (31)	3.5 ± 2.6 (21)
Total passes	4.1 ± 3.3 (58)	8.5 ± 3.3† (51)
Hand passes	1.7 ± 2.6 (24)	3.8 ± 2.6* (23)
Foot passes	2.4 ± 2.0 (34)	4.7 ± 2.0* (28)
Punt kicks	1.2 ± 1.4 (17)	0.3 ± 0.5 (2)
Scoring attempts	1.0 ± 1.5 (14)	3.5 ± 3.3* (21)
Pick-ups	1.1 ± 0.6 (15)	3.7 ± 2.0‡ (22)
Blocks	0.1 ± 0.3 (2)	0.3 ± 0.5 (2)
Interceptions	0.7 ± 1.0 (10)	4.0 ± 2.3‡ (24)
Solo taps	1.1 ± 1.6 (16)	5.3 ± 5.4* (32)
Solo hops	4.8 ± 2.9 (67)	12.3 ± 7.6† (74)
Touches	22.6 ± 12.1 (317)	55.5 ± 21.5‡ (333)

Values are mean ± SD (total number); *p<0.05 vs. 15-a-side game; †p<0.01 vs. 15-a-side game; ‡p<0.05 vs. 15-a-side game

Table 3.2 Team possessions during the 15 a-side game and the 7-a-side game

	Game	
	15 v 15	**7 v 7**
No of possessions (n)	40	41
Skills per possession (n)	7.1 ± 4.9	6.9 ± 3.7
Players per possession (n)	2.4 ± 1.5	2.2 ± 1.0
Time per possession (sec)	10.3 ± 8.1	10.1 ± 5.6

Values are mean ± SD

Table 3.3 Levels of enjoyment and perceived competence during the 7-a-side game and the 15-a-side game

	Game	
	15-a-side	**7-a-side**
Enjoyment	14.9 ± 4.5	19.2 ± 1.3†
Perceived competence	20.8 ± 3.2	22.6 ± 2.4

Values are mean ± SD; †p<0.01 v 15-a-side game

3.6.2 Study 1B: 7-a-side Game v same 7 players during the 15-a-side Game

Comparisons were also made between the number of selected skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence for the 7 players who played in both the 7-a-side and the 15-a-side game.

Descriptive statistics for the 7 players are summarized in table 3.4.

Table 3.4 Subject characteristics

Variable	**Mean ± SD**
Age (y)	14
Body mass (kg)	61.5 ± 10.7
Height (m)	1.7 ± 0.3
Body mass index ($kg \cdot m^2$)	20.8 ± 3.4
Body fat (%)	15.9 ± 6.7
$\dot{V}O_2max$ ($L \cdot min^{-1}$)	3.5 ± 0.4
$\dot{V}O_2max$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	56.9 ± 4.0
Maximal minute ventilation ($L \cdot min^{-1}$)	97.6 ± 12.0
Resting heart rate (bpm)	65.2 ± 7.5
Maximal heart rate (bpm)	204.3 ± 10.0
Systolic blood pressure (mmHg)	113.0 ± 8.5
Diastolic blood pressure (mmHg)	73.3 ± 8.3
Forced vital capacity (L)	4.2 ± 0.63

The skills performed by the 7 players during the 7-a-side game and the 15-a-side game are summarized in table 3.5. There were a similar number of high catches, chest catches, low catches, total passes, hand passes and blocks during the 7-a-side and the 15-a-side game. The total number of touches and the number of total catches, foot passes, punt kicks, scoring attempts, pick ups, interceptions, solo taps and solo hops were significantly higher during the 7-a-side than the 15-a-side game.

Peak heart rate, % Peak heart rate and estimated %$\dot{V}O_2$max were significantly higher ($p<0.01$) during the 7-a-side game than the 15-a-side game (Table 3.6). The levels of enjoyment were significantly higher ($p<0.01$) during the 7-a-side game than the 15-a-side game and there was no significant difference in the level of perceived competence between the two games (Table 3.7).

Table 3.5 Skills performed by same 7 players during the 7-a-side game and the 15-a-side game

	Game	
	15 v 15	**7 v 7**
Total catches	6.5 ± 5.0 (39)	9.7 ± 3.8* (58)
High catches	0.8 ± 0.6 (5)	0.8 ± 0.4 (5)
Chest catches	4.0 ± 3.2 (24)	5.3 ± 2.9 (32)
Low catches	1.7 ± 1.9 (10)	3.5 ± 2.6 (21)
Total passes	5.5 ± 4.8 (33)	8.5 ± 3.3 (51)
Hand pass	3.0 ± 3.5 (18)	3.8 ± 2.6 (23)
Foot pass	2.5 ± 2.9 (15)	4.7 ± 2.0* (28)
Punt kick	1.5 ± 1.0 (9)	0.3 ± 0.5* (2)
Scoring attempts	0.5 ± 1.2 (3)	3.5 ± 3.3* (21)
Pick up	1.3 ± 0.5 (8)	3.7 ± 2.0* (22)
Blocks	0.3 ± 0.5 (2)	0.3 ± 0.5 (2)
Interceptions	1.2 ± 1.2 (7)	4.0 ± 2.3* (24)
Solo tap	2.0 ± 2.0 (12)	5.3 ± 5.4* (32)
Solo hop	6.2 ± 2.8 (37)	12.3 ± 7.6† (74)
Touches	28.5 ± 14.5‡ (171)	55.5 ± 21.5* (333)

Values are mean ± SD (total number); *p<0.05 vs. 15-a-side game; †p<0.01 vs. 15-a-side game

Table 3.6 Physiological responses of same 7 players during the 7-a-side game and the 15-a-side game

	Game	
	15 v 15	**7 v 7**
Peak heart rate (bpm)	197.7 ± 11.6	204.3 ± 6.4†
Percent heart rate max	83.6 ± 6.9	89.4 ± 2.5†
Estimated %$\dot{V}O_2$max	74.7 ± 16.5	84.6 ± 10.1†

Values are mean ± SD; †p<0.01 v 15-a-side

Table 3.7. Levels of enjoyment and perceived competence by same 7 players during the 7-a-side game and the 15-a-side game

	Game	
	15 v 15	**7 v 7**
Enjoyment	15.0 ± 2.4	19.2 ± 1.3†
Perceived competence	21.9 ± 2.6	22.6 ± 1.1

Values are mean ± SD; †p<0.01 v 15-a-side game-

3.7 Summary

There were a significantly greater number of total touches, catches, passes, scoring attempts and a significantly higher level of enjoyment in the 7-a-side game than the 15-a-side game. Possession characteristics were not significantly different between the 7-a-side game and the 15-a-side game. Physiological responses, levels of enjoyment, total touches, total catches and scoring were significantly higher among the 7 players during the 7-a-side than the same 7 players during the 15-a-side game.

CHAPTER IV

RESEARCH STUDY 2

Effect of Altering the Number of Players and the Dimensions of the Playing Area on the Number of Selected Technical Skills Performed, Possession Characteristics, Physiological Responses and Levels of Enjoyment and Perceived Competence in 14 Year Old Boys

4 Rationale

It is well established that small sided games have been adopted in a number of team sports to facilitate the developmental abilities of children. Games can be modified by manipulating the duration, the number of players on each team, the dimensions of the playing area, scoring zones, playing rules, equipment etc.

A number of studies have evaluated the effect of altering the playing area on the technical requirements and physiological responses in children and adolescents during soccer (15, 60, 62, 70). To date, only one study has systematically examined the effect of modifying the playing surface area and player number on performance outcomes (55). A major limitation of this and other studies is the fact that the playing area was arbitrarily selected and was not based on the official size playing area. Previous studies have also failed to take account of the area available to each player. Furthermore, the majority of studies that have evaluated the effect of small sided games on technical

requirements and physiological responses in children have based their conclusions on a single game and failed to take account of game to game variability.

The purpose of this study was to examine the effect of altering the number of players and/or the playing area on the number of selected technical skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence in 14 year old Gaelic football players during 15-a-side and two different 9-a-side Gaelic football game formats. Each game was played under normal GAA rules and was videotaped for subsequent analysis of selected technical skills and possession characteristics.

4.1 Aim

To systematically evaluate the effect of altering the dimensions of the playing area on the number of selected technical skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence during two small sided game formats and 15-a-side games in 14 year old boys

4.1.1. Specific Aims

1. To compare the number of technical skills performed during a 15-a-side game where the playing surface area available to each player is 400m^2 and two 9-a-side game formats where the playing surface area available to each player is 400m^2 and 300m^2 respectively.

2. To compare the possession characteristics during a 15-a-side game where the playing surface area available to each player is 400m^2 and two 9-a-side game formats where the playing surface area available to each player is 400m^2 and 300m^2 respectively.

3. To compare the heart rate response and estimated $\dot{V}O_2$ during a 15-a-side game where the playing surface area available to each player is 400m^2 and two 9-a-side game formats where the playing surface area available to each player is 400m^2 and 300m^2 respectively.

4. To compare the levels of enjoyment and perceived competence during a 15-a-side game where the playing surface area available to each player is 400m^2 and two 9-a-side game formats where the playing surface area available to each player is 400m^2 and 300m^2 respectively.

4.1.2. Hypotheses

1. The mean number of technical skills performed will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the 9-a-side game formats.

2. The number of skills performed per possession, the number of players involved in each possession and the time per possession will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the 9-a-side game formats.

3. The % heart rate max and estimated percent $\dot{V}O_2$ max will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the 9-a-side game formats.

4. The levels of enjoyment and perceived competence will be significantly higher in the 9-a-side games than the 15-a-side games, and there will be no significant difference between the 9-a-side game formats.

4.2 Subjects

Members of three under-14 Gaelic football club teams who were playing in division 1 of the local county league volunteered. An initial visit was made to each club to explain the nature and risks of the study to parents and/or guardians, participants and club mentors.

Parents completed a health questionnaire to assess whether their child had any contraindications to participating in the study**.** Written informed consent and assent were obtained from the parents/guardians and children respectively (Appendix 2). The study was approved by the Research Ethics Committee at Dublin City University.

4.3 Overview of Study Design

The study design is outlined in figure 4.1. Participating teams played 2 official 15-a-side league games, and 6 specially organized 9-a-side games. Players wore a heart rate monitor during each game. After each game,

participants completed a questionnaire to assess their levels of enjoyment and perceived competence. Each game was videotaped for subsequent analysis of selected skills and possession characteristics.

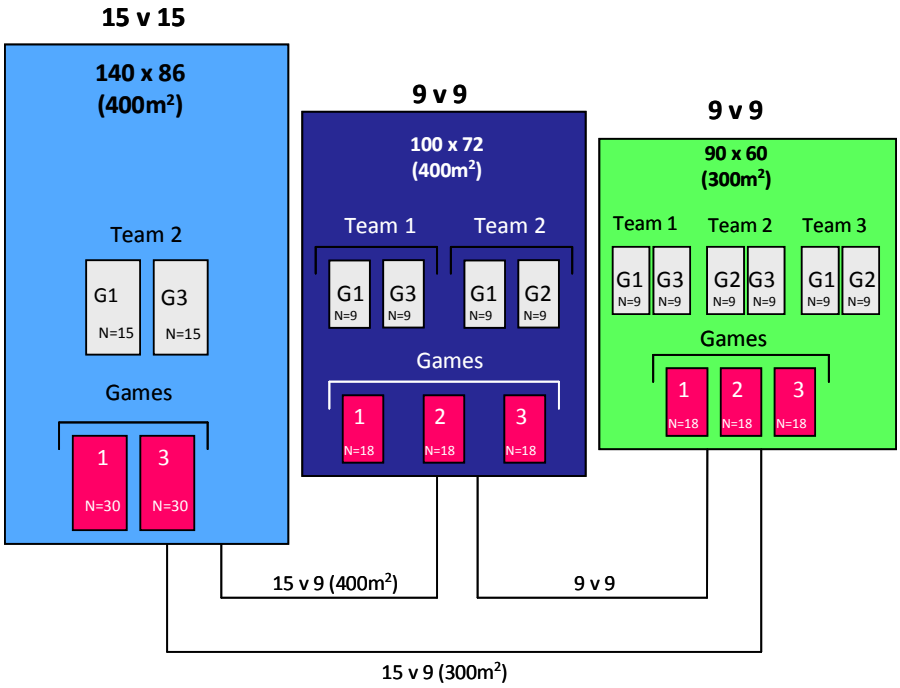


Figure 4.1. Schematic of Study 2 – Research design

The 15-a-side games were played on a standard adult size pitch measuring 140 metres x 86 metres and consisted of two 30 minute periods with a 10 minute interval between periods. The surface area available to each player was 400m^2.

The 9-a-side games consisted of two 15 minute periods. The half-time interval was < 2 minutes during which time the teams changed playing ends. Regular size portable goal posts measuring 6.5 metres x 2.5 metres were securely placed on each end line during the 9-a-side games. In order to keep

the surface area available to each player identical to the 15-a-side, the playing area for 3 of the 9-a-side games was 100 metres x 72 metres (9-a-side ($400m^2$)). The other three 9-a-side games were played on a pitch measuring 90 metres x 60 metres, and provided each player with a surface area of $300m^2$ (9-a-side ($300m^2$)).

A total of 24 boys who participated in the 9-a-side games agreed to make a single visit to Dublin City University to measure their lung function and maximal aerobic capacity ($\dot{V}O_2max$). Oxygen uptake during each game was estimated for each subject using the individual linear regression equation between $\dot{V}O_2$ and HR obtained during the progressive treadmill test.

4.4 Methods

4.4.1 Anthropometrics

Height and body mass were measured using portable scales (Seca 707 Balance Scales, GmbH, Hamburg, Germany) and a stadiometer (Seca model 220 GmbH, Hamburg, Germany) in accordance with the procedures used in study 1. Lang skinfold callipers (Cambridge Scientific Industries, MD) were used to measure double thickness subcutaneous triceps and subscapular adipose tissue. Percent body fat was calculated using the equation developed by Slaughter et al for children and youth (106).

4.4.2 Pulmonary Function Assessment

Forced expiratory volume in one second (FEV_1), and forced vital capacity (FVC), were determined using a spirometry system (Sensormedics Vmax 229, Yorba

Linda, CA, USA). A mass flow sensor coupled to a disposable mouthpiece was used to collect measurements of ventilation. The mass flow sensor was calibrated prior to each test using a 3 L volume syringe (Sensormedics, Yorba Linda, CA, USA).

4.4.3 Maximal Oxygen Uptake ($\dot{V}O_2max$)

Maximal aerobic capacity was assessed on a treadmill (Woodway ELG 55) using a ramp protocol. Following a 2.0 minute warm up at 134 $m \cdot min^{-1}$, the gradient was increased 0.2% every 12 seconds until the subject reached volitional exhaustion. Breath by breath expired oxygen, carbon dioxide, ventilatory volume and respiratory exchange ratios were determined using open circuit spirometry (Sensormedics Vmax 229 metabolic system, SensorMedics Corp., Yorba Linda CA). Maximal oxygen uptake was determined by averaging the 2 highest consecutive 30 second values.

The gas analyzers were calibrated prior to testing with standard gases of known concentration. A mass flow sensor (Sensormedics, Yorba Linda, CA, USA) was used to collect breath-by-breath measurements of ventilation. The mass flow sensor was calibrated prior to each test using a 3 L volume syringe (Sensormedics, Yorba Linda, CA, USA).

4.4.4 Heart Rate

Heart rate was continuously measured with a sampling frequency of 5 seconds using a wireless Polar team system (Polar Precision Performance SW 3.0, Kempele, Finland). Each heart beat was recorded and stored on a receiver

that was attached to an elastic strap and placed around the chest. The heart rate data was subsequently transferred from the receiver to a PC for analysis.

Oxygen uptake during each game was estimated for each subject using the individual linear regression equation between $\dot{V}O_2$ and HR obtained during the progressive treadmill test.

4.4.5 Levels of Enjoyment and Perceived Competence

The 4-item subscale of the Sport Commitment Model (87) designed for the youth sport domain, with items from the subscale adapted for Gaelic Games was used to measure enjoyment. These items have been validated in a sample of children with a mean age of 13.6 years from a wide range of sports, and have an internal reliability of α 0.90 (107). Items from the subscale were adapted for Gaelic football. The items are rated on a five-item Likert scale from 1 'not at all' to 5 'very much'. Items included, Did you enjoy playing Gaelic football in this game? (1) not at all, (5) very much. Were you happy playing Gaelic football in this game? (1) not at all, (5) very much. According to Carpenter et al., (107) these items have shown to demonstrate adequate internal reliability.

A series of questions based on the work of Eccles et al., (108) were included to assess perception of ability. These items are rated on a seven-item Likert scale from 1 'not at all good' to 7 'very good'. Questions include How good in Gaelic football are you? (1) not at all good (7) very good. If you were to list all the players on your team from the worst to the best, where would you

put yourself? (1) one of the worst (7) one of the best. Past research has demonstrated adequate psychometric properties for this scale (108, 109).

Children were requested not to sign their names to the questionnaires to ensure maximum confidentiality. The questionnaires were coded to link each child's physical performance and psychological data. Participants were assured that all responses were confidential and encouraged to ask questions to clarify any misunderstanding. They were also reminded after each game to relate their responses to the game that they had just played.

4.4.6 Video Analysis

Video footage was recorded from a camera (JVC PRO HD, London, England) that was mounted on a tripod on a purpose built elevated platform. The video footage from each game was downloaded as avi. files and stored on a La Cie Big Disk 500GB hard drive. Footage was analyzed using the Focus X2 version 1.4 system on a Latitude D800 Dell laptop computer (Dell, Dublin, Ireland). Focus X2 version 1.4 software notational analysis system (Elite Sports Analysis Limited, Scotland) was used to generate accurate and objective statistical information through a process of systematic observation. This software system combines video and statistical analysis into a software tool. The category design tool was used to create a category set appropriate to record information on selected skills.

The following skills were analyzed; total catches, high catches, chest catches, low catches, total passes, hand passes, foot passes, punt kicks, scoring

attempts, pick-ups. blocks, interceptions, solo taps, solo hops, and total touches. In addition, the number of possessions, time per possession and the number of players involved in each possession and the number of skills in each possession was analyzed.

4.4.7 Statistical Analysis

Data was compared between the total 30 minutes of the 9-a-side games, and the first half (30 minutes) of the 15-a-side games. A paired samples t-test or non-parametric Wilcoxan Signed Ranks Test was used to compare mean differences in selected skills, possession characteristics, physiological responses, and enjoyment and perceived competence levels between the two 15-a-side games. A one way Repeated Measures ANOVA or Friedman test was used to compare mean differences in selected skill, possession characteristics, physiological responses, and enjoyment and perceived competence levels between the three 9-a-side ($400m^2$) games and the three 9-a-side ($300m^2$) games. The combined data from the two 15-a-side games were compared to the combined data from the 9-a-side ($400m^2$) games and the 9-a-side ($300m^2$) games using a one way ANOVA or a Kruskal-Wallis test. A probability of $p \leq 0.05$ was accepted for statistical significance. Data were analyzed using SPSS (v14.0, SPSS Inc., IL).

4.5 Results

Subject characteristics and descriptive data are presented in table 4.1

Table 4.1 Subject characteristics

Variable	Mean ± SD
Age (y)	14.0 ± 0.5
Body mass (kg)	52.0 ± 8.7
Height (m)	1.6 ± 0.1
Body mass index ($kg \cdot m^2$)	19.2 ± 1.7
$\dot{V}O_2max$ ($L \cdot min^{-1}$)	3.1 ± 0.5
$\dot{V}O_2max$ ($ml \cdot kg^{1} \cdot min^{-1}$)	59.5 ± 7.3
Minute ventilation ($L \cdot min^{-1}$)	83.7 ± 13.6
Maximal heart rate (bpm)	200.0 ± 7.9
Forced vital capacity (FVC)	3.8 ± 0.7
FEV1	3.3 ± 0.6
FEV1/FVC	82.0 ± 18.1
Peak expiratory flow (PEF)	6.2 ± 1.4

4.5.1 Skills

4.5.1.1 Intra-game Variability

With the exception of the pick-up there was no significant difference in the mean number of skills performed between the two 15-a-side games (Table 4.2). There was no significant difference in the mean number of skills performed during the three 9-a-side ($400m^2$) games (Table 4.3) and the three 9-a-side ($300m^2$) games (Table 4.4).

4.5.1.2 Inter-Game Comparisons

Table 4.5 outlines the skills performed when averaged across the two 15-a-side games and the three 9-a-side ($400m^2$) games and the three 9-a-side ($300m^2$) games. There was no significant difference in the mean number of skills performed during the 9-a-side ($400m^2$) games and the 9-a-side ($300m^2$) games. The mean number of total catches, low catches, total passes, foot passes, scoring attempts, pick ups, interceptions and touches were significantly higher during the 9-a-side ($400m^2$) and the 9-a-side ($300m^2$) games than the 15-a-side games. The mean number of chest catches, hand passes and solo taps was significantly higher during the 9-a-side ($300m^2$) games than the 15-a-side games.

Table 4.2 Skills performed during the 15-a-side games

	Game	
	1	**2**
Total catches	6.5 ± 4.0 (195)	7.0 ± 4.9 (211)
High catches	0.8 ± 0.7 (24)	0.9 ± 1.3 (26)
Chest catches	4.0 ± 2.9 (120)	4.2 ± 3.2 (126)
Low catches	1.7 ± 1.4 (51)	2.0 ± 1.7 (59)
Total passes	6.0 ± 3.5 (180)	7.4 ± 4.8 (222)
Hand passes	3.0 ± 2.3 (90)	4.1 ± 3.3 (124)
Foot passes	3.0 ± 2.8 (90)	3.2 ± 2.8 (97)
Punt kicks	0.2 ± 0.5 (5)	0.0 ± 0.0 (0)
Scoring attempts	0.7 ± 0.9 (20)	0.9 ± 1.3 (27)
Pick-ups	1.3 ± 1.5 (39)	2.5 ± 1.7† (76)
Blocks	0.1 ± 0.3 (2)	0.3 ± 0.6 (8)
Interceptions	0.8 ± 1.3 (24)	0.8 ± 1.2 (24)
Solo taps	1.4 ± 2.6 (42)	1.5 ± 2.3 (47)
Solo hops	2.5 ± 3.4 (74)	1.9 ± 2.1 (56)
Touches	22.0 ±12.8 (661)	23.3 ± 13.6 (746)

Values are mean ± SD; (Total number of skills)
†$p<0.01$ v Game 1.
The mean values are based on the total number of players involved in each game (n=30)

Table 4.3 Skills performed during the 9-a-side (400m^2) games

	Game		
	1	**2**	**3**
Total catches	9.0 ± 5.0 (162)	9.6 ± 6.6 (173)	9.4 ± 4.6 (160)
High catch	0.9 ± 1.3 (17)	1.2 ± 1.3 (22)	1.2 ± 1.0 (20)
Chest catch	5.8 ± 3.5 (105)	5.0 ± 3.8 (90)	4.7 ± 2.8 (79)
Low catch	2.2 ± 1.6 (40	3.3 ± 2.9 (60)	3.6 ± 2.0 (61)
Total passes	8.7 ± 5.1 (156)	9.1 ± 5.2 (163)	10.0 ± 4.0 (170)
Hand pass	4.4 ± 3.0 (80)	3.7 ± 3.0 (67)	4.5 ± 3.2 (77)
Foot pass	4.2 ± 4.0 (76)	5.3 ± 3.4 (95)	5.5 ± 2.6 (93)
Punt Kick	0.1 ± 0.2 (1)	0.1 ± 0.3 (2)	0.0 ± 0.0 (0)
Scoring attempts	1.8 ± 1.7 (33)	2.2 ± 2.9 (39)	2.1 ± 2.5 (36)
Pick-up	2.8 ± 2.4 (50)	2.7 ± 2.4 (49)	3.7 ± 1.6 (62)
Blocks	0.1 ± 0.3 (2)	0.1 ± 0.2 (1)	0.2 ± 0.4 (4)
Intercepts	1.2 ± 1.7 (21)	1.0 ± 1.4 (18)	2.1 ± 2.5 (35)
Solo Tap	1.5 ± 1.8 (27)	3.5 ± 5.6 (63)	2.9 ± 3.5 (50)
Solo Hop	3.9 ± 3.0 (71)	3.0 ± 2.3 (54)	3.0 ± 4.4 (52)
Touches	30.5 ± 16.2 (609)	31.9 ± 21.6 (637)	33.8 ± 16.9 (709)

Values are mean ± SD; (total number of skills)
The mean values are based on the total number of players involved in each game (n=18)

Table 4.4 Skills performed during the 9-a-side (300m^2) games

	Game		
	1	**2**	**3**
Total catches	10.0 ± 4.7 (180)	9.6 ± 5.4 (144)	12.2 ± 4.9 (219)
High catch	1.2 ± 1.2 (21)	0.7 ± 0.9 (10)	1.2 ± 1.2 (21)
Chest catch	5.7 ± 2.5 (102)	5.7 ± 3.2 (85)	6.9 ± 3.6 (124)
Low catch	3.2 ± 2.6 (58)	3.3 ± 2.0 (50)	4.1 ± 2.5 (74)
Total passes	9.1 ± 4.1 (164)	9.3 ± 4.9 (140)	11.4 ± 3.7 (205)
Hand pass	4.7 ± 3.1 (85)	5.1 ± 3.9 (77)	6.3 ± 3.8 (114)
Foot pass	4.4 ± 2.6 (79)	4.2 ± 2.4 (63)	5.1 ± 2.4 (91)
Punt kick	0.1 ± 0.2 (1)	0.0 ± 0.0 (0)	0.1 ± 0.2 (1)
Scoring attempts	2.6 ± 2.7 (46)	1.8 ± 2.0 (27)	2.1 ± 2.3 (37)
Pick-up	2.2 ± 1.4 (39)	3.6 ± 2.6 (54)	2.9 ± 2.1 (53)
Blocks	0.2 ± 0.5 (4)	0.7 ± 0.3 (1)	0.3 ± 0.5 (6)
Interceptions	1.0 ± 1.0 (17)	1.9 ± 1.3 (28)	1.4 ± 1.0 (26)
Solo tap	2.5 ± 2.2 (45)	4.1 ± 3.3 (62)	2.2 ± 2.3 (39)
Solo hop	3.5 ± 3.7 (63)	2.7 ± 2.0 (40)	3.2 ± 2.1 (57)
Touches	32.8 ± 14.5 (655)	28.8 ± 19.3 (604)	35.8 ± 14.1 (752)

Values are mean ± SD; (total number of skills)
The mean values are based on the total number of players involved in each game (n=18)

Table 4.5 Skills performed during the 15-a-side games and the 9-a-side games

	Game		
	15 v 15 (400m^2)	**9 v 9 (400m^2)**	**9 v 9 (300m^2)**
Total catches	6.8 ± 4.5 (203)	9.4 ± 5.3† (169)	10.6 ± 5.0‡ (181)
High catch	0.8 ± 1.0 (25)	1.1 ± 1.2 (20)	1.0 ± 1.1 (17)
Chest catch	4.1 ± 3.1 (123)	5.2 ± 3.4 (93)	6.1 ± 3.1† (104)
Low catch	1.8 ± 1.6 (55)	3.1 ± 2.2† (55)	3.6 ± 2.4‡ (61)
Total pass	6.7 ± 4.2 (200)	9.3 ± 4.7† (167)	10.0 ± 4.3‡ (170)
Hand pass	3.6 ± 2.8 (107)	4.2 ± 3.0 (76)	5.4 ± 3.6† (92)
Foot pass	3.1 ± 2.7 (93)	5.0 ± 3.4† (91)	4.6 ± 2.4* (78)
Punt kick	0.1 ± 0.3 (2)	0.1 ± 0.2 (1)	0.0 ± 0.2 (1)
Scoring attempts	0.8 ± 1.1 (23)	2.0 ± 2.4† (36)	2.2 ± 2.3‡ (37)
Pick-ups	1.9 ± 1.7 (57)	3.0 ± 2.1† (55)	2.9 ± 2.1* (49)
Blocks	0.2 ± 0.5 (5)	0.1 ± 0.4 (3)	0.2 ± 0.5 (4)
Interceptions	0.8 ± 1.2 (24)	1.4 ± 1.4* (25)	1.4 ± 1.1* (24)
Solo tap	1.5 ± 2.4 (44)	2.6 ± 3.9 (47)	2.9 ± 2.7* (49)
Solo hop	2.2 ± 2.8 (65)	3.3 ± 3.3 (60)	3.1 ± 2.7 (53)
Touches	22.7 ± 13.1 (703)	32.4 ± 18.1‡ (652)	32.4 ± 16.1‡ (670)

Values are mean ± SD; (total number of skills)

[1]Data was averaged across the two 15-a-side games, the three 9-a-side (400m^2) games and the three 9-a-side (300m^2) games

*p<0.05 vs.15-a-side , †p<0.01 vs.15-a-side ‡ p<0.01 vs.15-a-side

4.5.2 Possessions

4.5.2.1 Intra-game Variability

There was no significant difference in the number of skills per possession, the number of players per possession or the time per possession between the two 15-a-side games (Table 4.6) between the three 9-a-side ($400m^2$) games (Table 4.7) or between the three 9-a-side ($300m^2$) games (Table 4.8).

4.5.2.2 Inter-Game Comparisons

Table 4.9 summarizes the number of skills per possession, the number of players per possession and the time per possession when averaged across the 15-a-side games, the 9-a-side ($400m^2$) games and the 9-a-side ($300m^2$) games. There was no significant difference in any of the possession characteristics between the 15-a-side games and the 9-a-side games

Table 4.6 Possession characteristics during the two 15-a-side ($400m^2$) games

	Game	
	1	**3**
Team possessions (n)	74	77
Skills per possession (n)	8.1 ± 4.9	8.7 ± 5.4
Players per possession (n)	3.2 ± 1.7	3.5 ± 1.9
Time per possession (sec)	12.0 ± 7.4	13.1 ± 9.9

Values are mean ± SD

Table 4.7 Possession characteristics during the 9-a-side (400m^2) games

	Game		
	1	**2**	**3**
Team possessions (n)	79	77	84
Skills per possession (n)	7.0 ± 4.2	7.7 ± 4.2	7.6 ± 4.4
Players per possession (n)	2.9 ± 1.6	3.0 ± 1.4	3.1 ± 1.4
Time per possession (sec)	11.0 ± 6.6	11.6 ± 6.8	12.4 ± 7.1

Values are mean ± SD

Table 4.8 Possession characteristics during the 9-a-side (300m^2) games

	Game		
	1	**2**	**3**
Team possessions (n)	84	64	80
Skills per possession (n)	8.1 ± 3.9	8.3 ± 4.7	7.4 ± 3.9
Players per possession (n)	3.3 ± 1.3	3.1 ± 1.4	2.9 ± 1.3
Time per possession (sec)	11.9 ± 6.5	12.9 ± 7.7	10.8 ± 6.4

Values are mean ± SD

Table 4.9 Possession characteristics during the 15-a-side game and the 9-a-side games*

	Game		
	15-a-side (400 m^2)	**9-a-side (400 m^2)**	**9-a-side (300 m^2)**
Team possessions (n)	76	80	76
Skills per possession (n)	8.2 ± 5.1	7.4 ± 4.3	7.9 ± 4.2
Players per possession (n)	3.3 ± 1.7	3.0 ± 1.4	3.1 ± 1.3
Time per possession (sec)	12.3 ± 8.2	11.7 ± 6.9	11.8 ± 6.8

Values are mean ± SD *Data is averaged across the two 15-a-side games and the three 9-a-side (400m^2) games and the three 9-a-side (300m^2) games

4.5.3 Physiological Responses

4.5.3.1 Intra-game Variability

Percent HR peak was higher during the first 15-a-side game than the second 15-a-side game (Table 4.10). There was no significant difference in the peak heart, or % HR peak between the three 9-a-side ($400m^2$) games (Table 4.11) or the three 9-a-side ($300m^2$) games (Table 4.12).

4.5.3.2 Inter-Game Comparisons

Table 4.13 outlines the peak heart rate, and % peak heart rate when averaged across the two 15-a-side games, the three 9-a-side ($400m^2$) games and the three 9-a-side ($300m^2$) games. There was no significant difference in the absolute or relative heart rate between the 15-a-side games and the 9-a-side games. There was no difference in estimated oxygen uptake between any of the games (Figure 4.2).

Table 4.10 Heart rate responses during the 15-a-side games

	Game	
	1	**2**
Peak heart rate (bpm)	201.3 ± 11.4	197.2 ± 5.8
%peak heart rate	85.3 ± 5.6	81.4 ± 7.4*

Values are mean ± SD; *p<0.05

Table 4.11 Heart rate responses during the 9-a-side ($400m^2$) games

	Game		
	1	**2**	**3**
Peak heart rate (bpm)	200.9 ± 11.4	197.7 ± 8.3	203.0 ± 6.6
%peak heart rate	85.0 ± 6.0	83.3 ± 8.2	86.9 ± 6.9

Values are mean ± SD

Table 4.12 Heart rate responses during the 9-a-side (300m^2) games

	Game		
	1	**2**	**3**
Peak heart rate (bpm)	204.0 ± 9.1	200.4 ± 10.6	199.4 ± 11.7
%peak heart rate	84.4 ± 4.5	84.0 ± 10.1	86.7 ± 16.7

Values are mean ± SD

Table 4.13 Heart rate responses averaged across the 15-a-side games, the 9-a-side (400m2) games and 9-a-side (300m^2) games

	Game		
	15-a-side (400 m^2)	**9-a-side (300 m^2)**	**9-a-side (400 m^2)**
Peak heart rate (bpm)	199.2 ± 9.1	201.2 ± 10.5	200.8 ± 9.2
%peak heart rate	83.3 ± 6.9	85.6 ± 17.3	85.7 ± 6.0

Values are mean ± SD

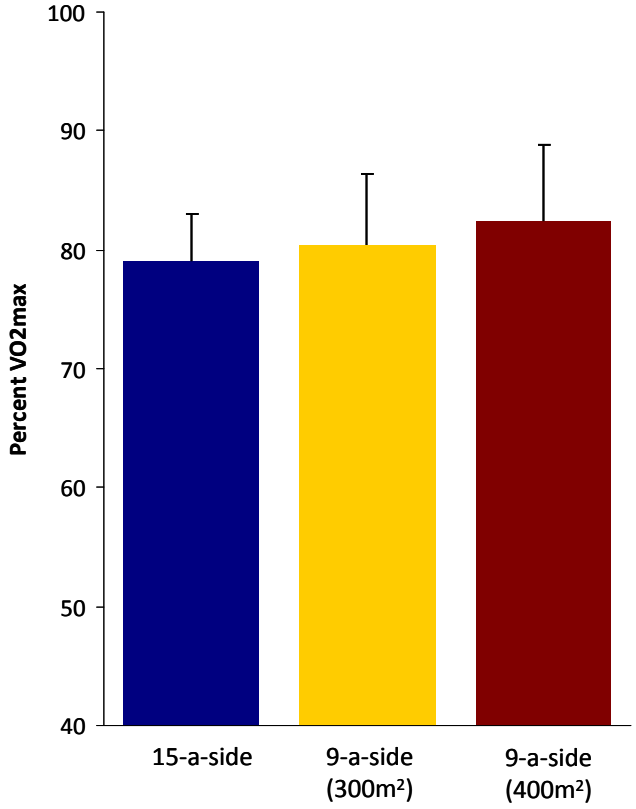


Figure 4.2 Estimated oxygen uptake averaged across the two 15-a-side games, three 9-a-side (400m^2) games and three 9-a-side (300m^2) games.

4.5.4 Enjoyment and Perceived Competence

4.5.4.1 Intra-Game Variability

There was no significant difference in the levels of enjoyment and perceived competence between two 15-a-side games (Table 4.14), between the three 9-a-side ($400m^2$) games (Table 4.15) or between the three 9-a-side ($300m^2$) games (Table 4.16).

4.5.4.2 Inter-Game Comparisons

Table 4.17 outlines the levels of enjoyment and perceived competence when averaged across the two 15-a-side games, the three 9-a-side ($400m^2$) games and the three 9-a-side ($300m^2$) games. There was no significant difference in the levels of enjoyment and perceived competence between the 15-a-side games and the 9-a-side games.

Table 4.14 Enjoyment and perceived competence during the 15 a-side ($400m^2$) games

	Game	
	1	**2**
Enjoyment	16.4 ± 4.0	16.2 ± 4.5
Perceived competence	21.4 ± 3.0	21.0 ± 3.2

Values are mean ± SD

Table 4.15 Enjoyment and perceived competence during the 9-a-side ($400m^2$) games

	Game		
	1	**2**	**3**
Enjoyment	17.4 ± 2.1	17.1 ± 2.8	16.7 ± 2.9
Perceived competence	21.3 ± 1.7	22.1 ± 3.1	22.3 ± 2.1

Values are mean ± SD

Table 4.16 Enjoyment and perceived competence during the 9 a-side ($300m^2$) games

	Game		
	1	**2**	**3**
Enjoyment	18.1 ± 1.9	17.1 ± 2.5	18.2 ± 2.6
Perceived competence	22.2 ± 3.6	21.2 ± 2.9	22.4 ± 2.6

Values are mean ± SD

Table 4.17 Enjoyment and perceived competence averaged across the 15-a-side games and the 9-a-side ($400m^2$) games and 9-a-side ($300m^2$) games

	Games		
	15-a-side ($400\ m^2$)	**9-a-side ($400\ m^2$)**	**9-a-side ($300\ m^2$)**
Enjoyment	16.3 ± 4.2	17.1 ± 2.6	17.8 ± 3.4
Perceived competence	22.2 ± 3.1	21.6 ± 2.8	21.8 ± 3.0

Values are mean ± SD

4.6 Summary

4.6.1 Intra-Game Variability

With the exception of the pick up and %HR during the 15-a-side game there were no significant differences in the number of skills performed, possession characteristics, heart rate responses and levels of enjoyment and perceived competence between two 15-a-side games. There was no significant difference in the number of skills performed, possession characteristics, heart rate responses and levels of enjoyment and perceived competence between the three 9-a-side ($300m^2$) games or between the three 9-a-side ($400m^2$) games.

4.6.2 Inter-Game Comparisons

When the data was averaged across the two 15-a-side games, the three 9-a-side ($300m^2$) games and the three 9-a-side ($400m^2$) games, there were a significantly higher number of catches, passes, scoring attempts and touches during the small sided games than the 15-a-side games. There was no significant difference in the number of skills performed between the 9-a-side games. There was no significant difference in the possession characteristics, physiological responses, or levels of enjoyment and perceived competence between the 9-a-side ($400m^2$) games and the 9-a-side ($300m^2$) games.

CHAPTER V

RESEARCH STUDY 3

To Evaluate the Effect of Altering the Playing Rules on the Number of Technical Skills Performed, Possession Characteristics, Heart Rate Responses and Levels of Enjoyment and Perceived Competence in Prepubescent Boys

5. Rationale

The Pathway to Elite Performance (PEP) strand of the GAA's Grassroots to National Programme provides young players with a progressive series of games and activities appropriate to their needs as they mature and develop from the recreational to elite performance levels (25).

As part of the PEP the GAA recently introduced small sided games called Go Games, for children between the age of 7-12 years. The games are designed to ensure that participants experience a sense of achievement and enjoyment through participation. A characteristic feature of the Go Games is that participants get to play for the entire game. The pitch dimensions, playing equipment and rules are modified to meet the needs of participants. Three different Go Games have been developed; "First Touch" for children ≤ 8 years of age, "Quick Touch" for children between the age of 9 and 10 years and "Smart Touch" for children between the age of 11 and 12 years.

The purpose of this study was to compare the number of selected technical skills performed, possession characteristics, heart rate responses and levels of enjoyment and perceived competence during 4 different 9-a-side game formats and between each of the

small sided games and a standard 15-a-side game. The playing surface area per player was 144m^2 during each of the small sided games and the 15-a-side game.

5.1 Aim

To evaluate the effect of altering the playing rules while keeping the surface area available to each player constant on the number of technical skills performed, possession characteristics, heart rate and levels of enjoyment and perceived competence in 10 year old boys.

5.1.1. Specific Aims

1. To compare the number of technical skills performed during a 15-a-side game and four different 9-a-side game formats

2. To compare the possession characteristics during a 15-a-side game and four different 9-a-side game formats

3. To compare the heart rate responses during a 15-a-side game and four different 9-a-side game formats

4. To compare the levels of enjoyment and perceived competence during a 15-a-side game and four different 9-a-side game formats

5.1.2 Hypotheses

1. The mean number of technical skills performed will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the small sided game formats.

2. The number of skills performed per possession, the number of players involved in each possession and the time per possession will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the small sided game formats.

3. The % heart rate max will be significantly higher during the 9-a-side games than during the 15-a-side game, and there will be no significant difference between the small sided game formats.

4. The levels of enjoyment and perceived competence will be significantly higher in the 9-a-side games than the 15-a-side game, and there will be no significant difference between the small sided game formats.

5.2 Subjects

Members of two North Dublin under-10 Gaelic football club teams volunteered. An initial visit was made to each club to explain the nature and risks of the study to parents and/or guardians, participants and club mentors. Written informed consent and assent was obtained from parents and children respectively. The assent form was read to each subject by his or her parent/guardian, or the researcher. The children were encouraged to ask questions prior to signing the assent form (Appendix 1). Parents also completed a health questionnaire to assess whether the child had any contraindications to exercise participation. The study was approved by the Research Ethics Committee at Dublin City University.

5.3 Overview of Study Design

The study design is outlined in figure 5.1. Each team played one 15-a-side game and four different 9-a-side games. The 4 small sided games were; i) traditional rules, ii) two-touch (modified), iii) Dublin Go-Games and iv) National Go-Games.

Mentors from the two clubs provided a list of all panel members from which 11 were randomly selected to participate in the small sided games. Each small sided game was played on a field measuring 65 metres x 40 metres. The dimensions of the playing area used for the 15-a-side game was altered to 108 metres x 40 metres to ensure the surface area available to each player was identical to the 9-a-side games. Portable goal posts measuring 3 metres x 1.8 metres were securely placed on each end-line, and a size 2 football was placed behind each goal along with the one in play.

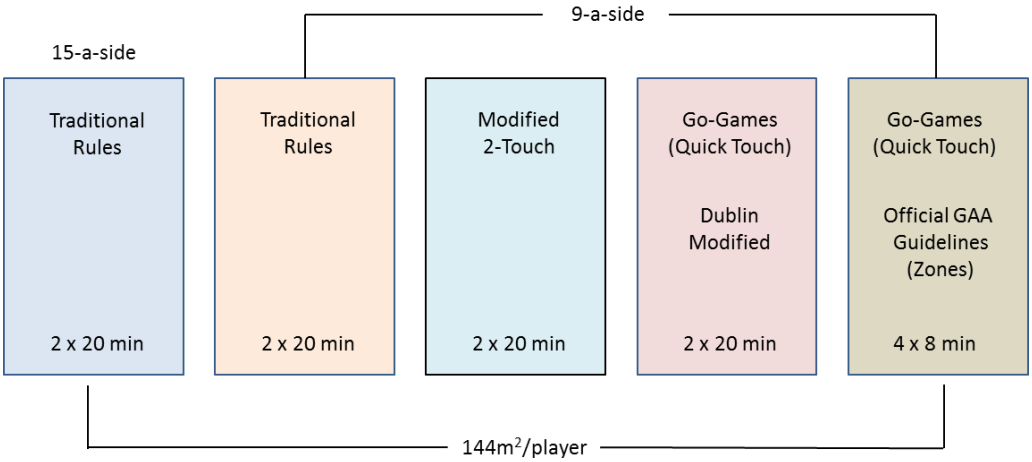


Figure 5.1 Schematic of Study 3- Research design

Each game was videotaped for subsequent analysis of selected technical skills and possession characteristics. Players wore a heart rate monitor during each game. After

each game, participants completed a questionnaire to assess their levels of enjoyment and perceived competence.

5.4 Methods

5.4.1 National Go-Games (Quick Touch)

Each game consisted of 4 quarters of 8 min duration. Teams consisted of a goalkeeper and 8 outfield players - 3 defenders, 2 mid-fielders and 3 forwards. The playing area was divided into 3 zones (figure 5.2), and with the exception of mid-field players, the other 7 players remained within the zone to which they were assigned. Positions were rotated at the beginning of each quarter. Midfield players were allowed to enter any zone in order to link with other players, but were required to return to the midfield zone for free kicks, sideline kicks or kick outs.

Two points were awarded when the ball was played over the crossbar between the uprights, three points were awarded when the ball was played under the crossbar between the uprights and one point was awarded for a block.

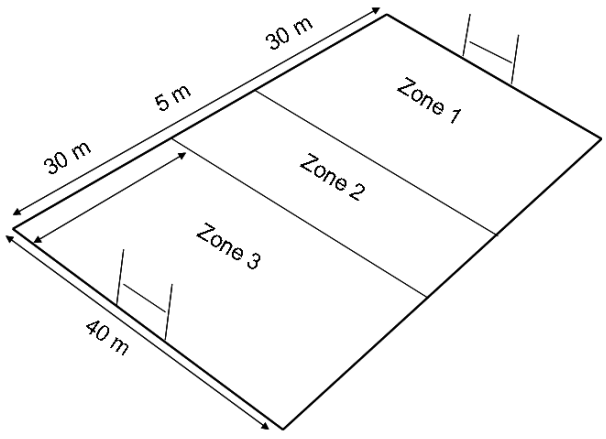


Figure 5.2 Playing area lay-out for the National Go-Games

The following playing rules were used:

- After a score or wide ball, the play commenced with the goalkeeper kicking the ball out of his hands.
- The goalkeeper was allowed to advance 20 m for a kick out.
- The side-to-side shoulder charge was permitted.
- The ball could only be played by kicking it or striking it with the fist.
- The ball could only be kicked with the non-dominant foot and fisted with the non-dominant fist during the second and fourth quarters. A free was awarded to the opposition if the dominant foot/fist were used. The children wore a fluorescent orange band on their non-dominant leg so as to enable the researcher to determine which leg was used to kick the ball.
- Players were restricted to one bounce and one toe tap per possession.
- The ball could be lifted off the ground with the hands, provided the player was on his feet.
- Free kicks were taken by the player who was fouled.
- When an opponent fouled the ball, the player nearest to the ball took the free kick.
- When a free was awarded the ball was handed to the player taking the kick. Non-compliance resulted in the ball being advanced 5 metres.
- Sideline kicks were taken from the hands by the opponent nearest to where the ball crossed the sideline.
- The opposition was awarded a free kick from the 30 metre line when a defender played the ball over his team's end line.

- Opposing players were required to be at least 5 metres from the player taking a free kick, sideline kick, 30 m kick or kick out.

5.4.2 Dublin Go Games

The Dublin Go-Games consisted of two 20 minute periods interspersed with a 10 minute interval at half time. Teams changed ends at half-time. The following positions were assigned; 1 goalkeeper, 3 defenders, 3 attackers and 2 mid-field players. However, the exact positioning of each player during the game varied depending on the tactics employed by team management. The following modifications were made to the Dublin Go-Game:

- Absence of zones.
- Players were restricted to the use of their non-dominant foot during the first 5 minutes of first and second half of the game.
- The ball could only be lifted off the ground using the conventional pick-up.
- Opposing players were required to be at least 13 metres from the player taking a free kick, sideline kick, or kick out.
- Goalkeepers were allowed to advance 10 metres for a kick out.
- Two points were awarded when the ball was played over the crossbar between the uprights, 1 point was awarded when the ball was played under the crossbar between the uprights, and one point was awarded for a high catch.

5.4.3 Modified 9-a-Side Game

The modified 9-a-side game consisted of two 20 minute periods interspersed with a 10 minute interval at half time. Teams changed playing ends at half-time. The following positions were assigned; 1 goalkeeper, 3 defenders, 3 attackers and 2 mid-field players. However, the exact positioning of each player during the game varied depending on the tactics employed by team management. The only modification to the official rules was the restriction of players to a maximum of two touches when in possession of the ball, i.e. they could take no more than two solo runs or a solo and a hop before playing the ball.

5.4.4 Normal-9-a-Side Game

The normal 9-a-side game was played using the official GAA football rules. Teams were comprised of 9 players; a goalkeeper, three defenders, two midfielders and three forwards. The exact positioning of each player varied depending on the tactics employed by team management. The game involved two 20 minute periods and a 10 min break at half time.

5.4.5 15-a-Side Game

The 15-a-side game was played using the official GAA football rules. There were 15 players on each team; a goalkeeper, six defenders, two midfielders and six forwards. The exact positioning of each player varied depending on the tactics employed by team management. The game involved two 20 minute periods and a 10 min break at half time. The dimensions of the playing area were altered (108 metres x 40 metres) to ensure that each player had the same surface area ($144m^2$) per player as in the 9-a-side games.

5.4.6 Heart Rate

Heart rate was continuously measured with a sampling frequency of 5 sec using a wireless Polar team system (Polar Precision Performance SW 3.0, Kempele, Finland). Each heart beat was recorded and stored on a receiver that was attached to an elastic strap and placed around the chest. The heart rate data was subsequently transferred from the receiver to a PC for analysis.

5.4.7 Levels of Enjoyment and Perceived Competence

The 4-item subscale of the Sport Commitment Model (87) designed for the youth sport domain, with items from the subscale adapted for Gaelic Games was used to measure enjoyment (Appendix 1). These items have been validated in a sample of children with a mean age of 13.6 years from a wide range of sports, and has an internal reliability of α 0.90 (89). Items from the subscale were adapted for Gaelic football. The items were rated on a five-item Likert scale from 1 'not at all' to 5 'very much'. Items included, Did you enjoy playing Gaelic football in this game? (1) not at all, (5) very much. Were you happy playing Gaelic football in this game? (1) not at all, (5) very much. These items have shown to demonstrate adequate internal reliability (107).

A series of questions based on the work of Eccles et al., (108) were included to assess perception of ability. These items were rated on a seven-item Likert scale from 1 'not at all good' to 7 'very good'. Questions included "How good in Gaelic football are you? (1) not at all good, (7) very good "If you were to list all the players on your team from the worst to the best, where would you put yourself ? (1) one of the worst (7), one of the

best. Past research has demonstrated adequate psychometric properties for this scale (108, 109).

Children were requested not to sign their names to the questionnaires to ensure maximum confidentiality. The questionnaires were coded to link each child's physical performance and psychological data. Participants were assured that all responses were confidential and encouraged to ask questions to clarify any misunderstanding. They were also reminded after each game to relate their responses to the game that they had just played.

5.4.8 Video Analysis

Video footage was recorded from a camera (JVC PRO HD, London, England) that was mounted on a tripod, on a purpose built elevated platform. The video footage from each game was downloaded as avi. files and stored on a La Cie Big Disk 500GB hard drive. Footage was analyzed using the Focus X2 version 1.4 system on a Latitude D800 Dell laptop computer (Dell, Dublin, Ireland). Focus X2 version 1.4 software notational analysis system (Elite Sports Analysis Limited, Scotland) was used to generate accurate and objective statistical information through a process of systematic observation. This software system combines video and statistical analysis into a software tool. The category design tool was used to create a category set appropriate to record information on selected skills.

The following skills were analyzed; total catches, high catches, chest catches, low catches, total passes, hand passes, foot passes, punt kicks, scoring attempts, pick-ups. blocks, interceptions, solo taps, solo hops, and touches. In addition, the number of

possessions, time per possession and the number of players involved in each possession and the number of skills in each possession was analyzed.

5.4.9 Statistical Analysis

Data was compared between the total 40 minutes of three 9-a-side games, and the total 40 minutes of the 15-a-side game. When comparing the National go game it was only 32 minutes as this game consists of four 8 minute quarters. The data from both participating teams were combined for each game. Comparisons between the four 9-a-side games were undertaken using a one way repeated measures ANOVA. An independent t-test was used to compare each small sided game to the 15-a-side game. A probability of $p \leq 0.05$ was accepted for statistical significance. Data were analyzed using SPSS (v14.0, SPSS Inc., IL).

5.5 Results

The descriptive statistics are summarized in table 5.1. The mean number of selected skills performed during the 15-a-side game and the small sided games are summarized in table 5.2. There was no significant difference in the mean number of total catches, low catches, total passes, scoring attempts, blocks, interceptions, solo taps, solo hops or total touches between the 4 small sided games. There was a significantly higher number of hand passes ($p<0.05$) and high catches ($p<0.05$) during the normal small sided game than the Dublin Go Game, and a significantly higher number of chest catches ($p<0.01$) and foot passes ($p<0.05$) during the modified small sided game than the Dublin Go Game. The mean number of chest catches ($p<0.01$) and pick ups ($p<0.05$) was significantly higher during the modified small sided game than the National Go Game, and the mean number of punt kicks ($p<0.01$) and pick ups ($p<0.05$) was significantly higher during the Dublin Go Games than the National Go Games.

There were a significantly higher number of pick-ups and total touches in the normal small sided game, the modified small sided game and Dublin Go Game than the 15-a-side game. The number of scoring attempts was significantly higher in the modified small sided game and Dublin Go Game than the 15-a-side game. Compared to the 15-a-side game there was a significantly higher number of, total passes and foot passes during the modified small sided game. The mean number of punt kicks was significantly higher ($p<0.001$) and the mean number of chest catches was significantly lower ($p<0.01$) in modified small sided game than the 15-a-side game.

There was no significant difference in the number of skills per possession, the number of players involved in each possession and the time per possession between any of the small sided games. There was no significant difference in the number of skills per possession, the number of players involved in each possession and the time per possession between any the small sided games and the 15-a-side game (Table 5.3).

There was no significant difference in the peak heart rate during any of the small sided games, or between any of the small sided games and the 15-a-side game. The % peak heart rate was significantly higher ($p<0.01$) during the normal small sided game and the modified small sided game than the National Go Game (Table 5.4). Compared to the 15-a-side game the % peak heart rate was significantly lower during the National Go Game (Table 5.4).

The levels of enjoyment were significantly higher during the Normal small sided game ($p<0.05$) and Dublin Go Game ($p<0.01$) than the National Go Game (Table 5.5). There was no significant difference in the level of enjoyment between any of the small sided games and the 15-a-side game. There was no significant difference in the level of perceived competence between the small sided games or between the small sided games and the 15-a-side game.

Table 5.1 Subject demographics

Variable	**Mean ± SD**
Body mass (kg)	35.0 ± 5.8
Height (m)	1.4 ± 0.7
Body mass index ($kg \cdot m^2$)	17.3 ± 1.5

Values are means ± SD

Table 5.2 Mean number of selected skills performed during the 15-a-side game and the small sided games

	Small Sided Games				
	Normal Rules	**Modified Rules**	**Dublin Go-Games**	**National Go-Games**	**Regular 15-a-side**
Total catches	8.8 ± 5.8 (132)	13.0 ± 5.9 (195)	11.4 ± 4.3 (171)	11.3 ± 6.0 (169)	7.9 ± 3.9 (119)
High catches	0.7 ± 0.7† (10)	1.9 ± 2.0 (28)	2.1 ± 1.6 (31)	1.9 ± 1.9 (28)	1.5 ± 1.4 (22)
Chest catches	4.8 ± 3.5 (72)	6.9 ± 3.6†# (104)	3.9 ± 1.9[2] (59)	4.7 ± 3.2[1] (70)	4.3 ± 2.7 (65)
Low catches	3.3 ± 2.7 (50)	4.2 ± 2.4 (63)	5.4 ± 2.3 (81)	4.7 ± 2.5 (71)	2.1 ± 1.3 (32)
Total passes	7.8 ± 4.9 (117)	10.7 ± 4.4[2] (161)	8.2 ± 2.6 (123)	7.6 ± 5.3 (114)	5.3 ± 3.4 (80)
Hand passes	1.0 ± 1.2† (15)	2.0 ± 2.0 (30)	2.8 ± 2.5 (42)	2.5 ± 2.2 (38)	1.4 ± 2.0 (21)
Foot passes	6.8 ± 4.6 (102)	8.7 ± 4.4*[2] (131)	5.4 ± 2.7 (81)	5.1 ± 3.9 (76)	3.9 ± 2.2 (59)
Punt kicks	2.7 ± 3.0 (41)	2.3 ± 2.0 (35)	4.3 ± 2.9‡[3] (64)	1.0 ± 0.9 (15)	1.2 ± 1.41 (18)
Scoring attempts	1.8 ± 1.9 (27)	3.1 ± 3.5[2] (47)	3.5 ± 3.3[2] (52)	2.3 ± 2.8 (34)	1.8 ± 1.9 (27)
Pick ups	4.7 ± 2.7[1] (71)	6.3 ± 4.3‡[2] (95)	4.5 ± 2.3#[1] (68)	2.3 ± 1.4 (35)	2.6 ± 2.4 (39)
Blocks	0.2 ± 0.4 (3)	0.7 ± 1.0 (11)	0.3 ± 0.5 (5)	0.5 ± 0.7 (8)	0.1 ± 0.4 (2)
Total intercepts	4.5 ± 3.5 (68)	7.1 ± 6.3 (106)	5.3 ± 2.4 (79)	3.7 ± 2.5 (55)	3.1 ± 3.4 (46)
Solo taps	1.4 ± 2.3 (21)	0.4 ± 0.6 (6)	0.9 ± 1.3 (13)	0.3 ± 0.6 (5)	0.5 ± 0.9 (7)
Solo hops	4.9 ± 5.4 (74)	4.9 ± 4.8 (74)	4.2 ± 4.0 (63)	3.7 ± 3.2 (56)	2.6 ± 2.6 (39)
Touches	39.1 ± 21.9[1] (586)	50.2 ± 18.7[3] (753)	44.7 ± 14.0[3] (670)	32.6 ± 17.5 (489)	26.7 ± 12.7 (401)

Values are means ± SD;

*p<0.05 vs. Dublin Go-Game; †p<0.01 vs. Dublin Go Game; # p<0.05 vs.National Go-Game; ‡ p<0.01 vs. National Go-Game

[1]p<0.05 vs. 15-a-side; [2]p<0.01 vs. 15-a-side; [3]p<0.001 vs. 15-a-side

Table 5.3 Team possessions during the 9-a-side games and the 15-a-side game

Variable	Small Sided Games				
	Normal Rules	Modified Rules	Dublin Go-Games	National Go-Games	Regular 15-a-side
Possessions (n)	144	161	162	116	150
Time per possession (sec)	6.5 ± 4.4	6.0 ± 5.0	6.2 ± 4.9	6.5 ± 4.6	5.9 ± 4.4
Players per possession (n)	1.8 ± 0.9	1.9 ± 1.0	1.9 ± 1.0	2.0 ± 0.9	1.9 ± 1.1
Skills per possession (n)	4.4 ± 2.1	4.1 ± 2.5	4.2 ± 2.5	4.6 ± 2.6	4.3 ± 2.7

Values are mean ± SD

Table 5.4 Heart rate responses during the 9-a-side games and the 15-a-side game

Variable	Small sided Games				
	Normal Rules	Modified Rules	Dublin Go-Games	National Go-Games	Regular 15-a-side
Peak HR	206.7 ± 3.5	203.2 ± 7.8	195.1 ± 29.2	197.3 ± 9.9	200.1 ± 9.5
%HR	82.5 ± 3.5†	82.5 ± 5.2†	76.9 ± 12.6	72.3 ± 5.7*	77.9 ± 7.3

Values are mean ± SD; † p<0.01 vs. National Go-Game; *p<0.05 vs. 15-a-side

Table 5.5 Enjoyment and perceived competence during the 9-a-side games and the 15-a-side game

Variable	Small Sided Games				
	Normal Rules	Modified Rules	Dublin Go-Games	National Go-Games	Regular 15-a-side
Enjoyment	17.7 ± 2.8*	16.7 ± 4.5	18.6 ± 2.1†	14.9 ± 4.1	17.1 ± 3.8
Perceived competence	22.7 ± 4.8	23.3 ± 3.4	23.0 ± 3.3	23.2 ± 3.4	22.0 ± 3.8

Values are mean ± SD; *p<0.05 vs. National Go Game, †p<0.01 vs. National Go-Game.

5.6 Summary

The mean number of total catches, low catches, total passes, scoring attempts, blocks, interceptions, solo taps, solo hops and touches were similar in the four small sided games. The normal small sided game and the modified small sided game elicited a significantly higher relative % peak heart rate than the National Go Game. Enjoyment levels were significantly lower in the National Go Game than the normal small sided game and Dublin Go Game. There was no significant difference in the possession characteristics or perceived competence between the sided games.

There was no significant difference in the possession characteristics, enjoyment, perceived competence or the mean number of total catches, high catches, low catches, hand passes, blocks, interceptions, solo tops and solo hops between any of the small sided games and the 15-a-side game. With the exception of the National Go Games there was no significant difference in %HR between the small sided games and the 15-a-side game.

CHAPTER VI

DISCUSSION

6. Introduction

The Gaelic Athletic Association is the largest sporting body in Ireland and is responsible for the organization of five different games - Gaelic football, hurling, camogie handball and rounders. Gaelic football is the most popular game and competitions are organized at underage and senior level.

Until quite recently formal Gaelic football competitions were organized for children as young as 10 years. In many instances the playing surface area, number of players involved and the playing rules were similar to those used in senior competitions. Children were often assigned rigid positional responsibilities at ages when their spatial awareness and technical skills did not lend themselves to a practical understanding of the complexity of a full 15-a-side game.

Small sided games played on smaller fields, with fewer players have been advocated as an alternative to 15-a-side games (14, 15, 70). A reduced number of players on appropriately sized pitches may provide an ideal opportunity to develop skills, repeatedly experience basic tactical problems, stress the various physiological systems, and promote long-term player development. The opportunity afforded by small sided games for children to actively participate is directly related to fun and enjoyment (9). The provision of more playing time may also encourage maximum individual participation and

increase skill mastery experiences thereby promoting perceptions of competence, self-esteem and self-confidence (7).

Research in Gaelic games lags considerably behind that of other field sports. The series of studies undertaken as part of this PhD thesis compares the number of selected skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence during small sided games and 15-a-side games in children between the age of 10 and 14 years. The first two studies examined the effect of altering the number of players and the dimensions of the playing area. The third study examined the effect of altering the playing rules while keeping the number of players and the playing area constant.

6.1 Study 1 and Study 2 - Technical Skills and Possession Characteristics

In the first two studies, it was hypothesised that among 14 year old boys, 7-a-side and 9-a-side games would be more effective than 15-a-side games in facilitating player involvement and would result in greater physiological loading and levels of enjoyment and perceived competence.

A consistent finding was that the small sided games provided players with a greater opportunity for passing, catching and shooting than the 15-a-side games. With few exceptions the mean number of skills performed per player was significantly higher in each of the small sided games (7-a-side game, 9-a-side ($300m^2$) and 9-a-side ($400m^2$)) than the 15 a-side games. The fact that there was no significant difference in the mean number of skills performed between the two 9-a-side game formats, indicates that the various

small sided game formats are equally effective in providing opportunities to perform the technical skills of Gaelic football.

The majority of previous studies that have examined the effect of small sided games on selected match activities in children and adolescents have involved soccer (1). Surprisingly, only 3 studies have compared selected match activities during a small sided game and a standard 11-a-side soccer game (10, 13, 14, 59). Although each of the three studies compared selected match activities during a small sided game and a standard 11-a-side soccer game, the playing surface area in each of the small sided games was arbitrarily selected and did not take account of the surface area available to each player. In fact the surface area available to each player was 23% to 42% lower in the small sided games than the 11-a-side games. It was therefore not possible to determine whether differences in the number of skills performed between the small sided games than the 11-a-side games were due to the number of players per team, the dimensions of the playing area, or a combination of both.

In the present study, the dimensions of the playing area was modified to ensure the surface area available to each player during the 7-a-side ($320m^2$) game and 9-a-side game ($400m^2$) games was the same as during the 15-a-side ($320m^2$) game and the 15-a-side ($400m^2$) game respectively. The significantly higher number of catches, passes, scoring attempts, and touches during the 7-a-side game and 9-a-side ($400m^2$) game than the respective 15-a-side games suggests that the smaller number of players rather than the dimensions of the playing area was responsible for the higher number of technical skills performed in the small sided games. Further evidence that small sided Gaelic

football games increased player involvement is the fact that the total number of catches, passes, scoring attempts, and touches were also significantly higher during the 9-a-side ($300m^2$) game than the 15-a-side ($400m^2$) game.

Previous studies that have evaluated the effect of small sided games on technical requirements in children have based their conclusions on a single game and failed to account for game to game variability (13, 14, 59). The design of the present study allowed the examination of game to game variability in the mean number of selected technical skills performed, possession characteristics, physiological responses and levels of enjoyment and perceived competence during small sided games and 15-a-side games.

In the present study the mean number of technical skills performed was similar between the two 15-a-side games and between the three 9-a-side ($400m^2$) games and between the three 9-a-side ($300m^2$) games. The fact that there were no significant changes in the number of selected technical skills performed within each game format indicate that the findings are not due to random error associated with analyzing only one game.

The first study was designed to allow the comparison in the number of technical skills performed during a 7-a-side ($320m^2$) game and by the same 7 players during a 15-a-side ($320m^2$) game. Five of the 6 outfield players (83%) had at least one scoring attempt during the 7-a-side game, and only one of these players had a scoring opportunity during the 15 a-side game. Only 50% of outfield players had a minimum of one scoring attempt during the 15-a-side game compared to 83% in the 7-a-side game. This is an important finding considering that the primary objective of a team in possession is to score.

A team possession was defined as two or more touches performed by one or more players on the same team while attempting to retain possession of the ball. To our knowledge no previous studies involving small sided games have characterized the number of possessions, time per possession, number of skills performed during each possession or the number of players involved during each team possession. Although there was no significant difference in the possession characteristics between the 7-a-side game and the 15-a-side game, each team possession in the 7-a-side game involved 2.2 players (31%) of the team of 7 players compared to only 2.4 players (16%) in the 15 a-side game ($320m^2$). Similarly, 33% of players were involved in each team possession during both 9-a-side game formats compared to 22% in the 15 a-side ($400m^2$) game. Since the total time per possession was similar in the small sided games and the 15 a-side games, the findings indicate a greater player involvement in the same time period during small sided games than 15-a-side games.

The number of touches (intentional contact with the ball) can also be used to give an estimation of player involvement during a game. Each player had approximately 23 ball touches during the 15-a-side game compared to 55 in the 7-a-side ($320m^2$) game and 35 in both 9-a-side game formats. The higher number of ball touches demonstrates that the players were more involved in the small sided games than the 15 a-side games.

6.2 Go Games

The Go Games are 9-a-side Gaelic football games developed for children between the ages of 7-12 years. They are now mandatory for all GAA football competitions involving children under the age of 12 years. A characteristic feature of the Go Games is that participants play for the entire game and the pitch dimensions, playing equipment and playing rules are modified. The Go Games provided an ideal opportunity to systematically examine the effect of altering the playing rules and playing equipment on technical skills, possession characteristics, physiological responses and level of enjoyment and perceived competence in children.

The original Go Games (National Go Games) are played over 4 quarters of 8 min duration on a surface area measuring 65 m x 40 m. A large number of modifications were made to the normal playing rules including the restriction of players (excluding midfielders) to one of three playing zones during each quarter. Positions are rotated at the beginning of each quarter. The Go Games were designed as a template and mentors are encouraged to alter various aspects of the playing rules to suit their own requirements. For example, the administrative unit of the GAA in County Dublin has made a number of modifications to the official Go Games including the removal of playing zones and playing two 20 minute periods rather than four 8 minute periods.

The present study compared the number of selected technical skills performed, possession characteristics, physiological responses and level of enjoyment and perceived competence between the National Go Games and the Dublin Go Games in 10 year old

boys. In addition, the teams played a 9-a-side game with normal rules and a 9-a-side game where players were restricted to two touches. Each of the small sided game formats were compared to each other and to a normal 15-a-side game. The playing area available to each player was identical in all games.

With relatively few exceptions there was no significant difference in any of the technical skills performed, total number of touches or possession characteristics during the various small sided games. There were approximately 4.3 skills performed by an average of 2 players during each team possession which ranged in duration from 6.0 - 6.5 sec.

With the exception of solo taps and solo hops there were significant differences between the small sided games and the 15-a-side game in the number of technical skills performed and the total number of touches per player with a greater number being recorded for the small sided games. Although the possession characteristics were similar between the small sided games and the 15-a-side game, the smaller number of players in the small sided games indicates a higher level of player involvement during these games. In terms of maximizing children's involvement and performing technical skills, small sided games are more appropriate than the adult format 15-a-side games. Despite this, there was no evidence that one type of small sided game was superior to another.

In addition to facilitating player involvement, small sided games can be organized to provide players with the opportunity to develop their technical and tactical skills under similar conditions to those encountered during a 15-a-side game. The specificity associated with modified games may also simulate the movement patterns and

physiological demands of the official 15-a-side game, and increase the likelihood of transfer to the competitive environment.

The major skills of Gaelic football such as catching, passing, shooting and blocking are usually performed under the conditions of an unpredictable constantly changing environment and are referred to as open skills. According to Schmidt`s (110) Schema theory individuals have a generalized motor program which controls a class of actions that have similar requirements. Each class of action e.g. passing, kicking, running has its own generalized motor program (GMP) stored within the individual. The GMP is flexible and can be run in many different ways (speeds, angles, forces) depending on the demands of the situation. Values for these parameters of speed, angle, force is determined by the individual based on a set of rules (schema) i.e., " if this kick needs to be long, then the kick requires an appropriate force" which must be selected in order to complete the specific tasks. Games contain variations which facilitate the development of schemas (111-113). The greater the number of varied responses experienced by the learner in practice, the stronger and more enriched the schema becomes and the greater the range of responses (including novel responses) that can be generated. Small sided games are an ideal way to provide children with a wide range of experiences required to develop match play related schemas (113-115).

Team sports such as Gaelic football requires a considerable amount of contextual processing. The ability of children to make decisions is constrained by their capacity to process information. The relationship between a player and the situation around him/her is dynamic, and ideally, skills should emerge in and around the game environment. There

is evidence that expert performers in sport are better able to recognize and recall domain specific patterns of play, and accurately select the correct option from a variety of alternatives (21). They can make decisions rapidly and efficiently resulting in intuitive performance under pressure and in the most complex situations (13, 15, 16, 22). Exposure to a variety of small sided games during the prepubescent and adolescent years may exert an enduring influence on the acquisition of expert perceptual-cognitive and contextual decision-making skills (23). Future studies should examine how small sided games influence perceptual-cognitive and decision-making skills.

6.3 Physiological Responses

Heart rate is a robust index of physiological stress in team sports involving intermittent activity (1, 64, 68, 78, 116-120). Studies examining the heart rate response during small sided games have been equivocal. Platt et al., (15) found that soccer players had a higher heart rate and spent more time in high intensity activities in 3 v 3 games than 5 v 5 games. Hill-Haas et al.,(55) reported higher heart rates in 16 year old soccer players during 2 v 2, than 4 v 4, and 6 v 6 soccer games. The dimensions of the playing area were adjusted to insure that the surface area available to each player was constant during each game. A limitation of this study is the fact that the pitch size was determined arbitrarily and there were no comparisons with an 11-a-side game. In contrast, Jones and Drust (60), found no significant difference in heart rate among 7 year old children during 4 v 4 and 8 v 8 soccer games. It is unlikely that 7 year old children possess the requisite skill levels to ensure the 4 v 4 game is played at an intensity required to maintain a sustained elevation in heart rate. Capranica et al., (59) compared heart rate during a small sided game (7-a-

side) and an official 11-a-side soccer game in children. There was no significant difference in the heart rate response despite the fact that the surface area available to each player was almost 50% greater in the 11-a-side game than the 7-a-side game.

The present study is the first to examine the physiological responses during small sided games in which the surface area available to each player was identical to the official game. The percent heart rate max was higher in the 7-a-side game than the 15-a-side ($320m^2$) game. However, there was no significant difference in average percent heart rate between the 9-a-side ($300m^2$) games, the 9-a-side ($400m^2$) games and the 15-a-side ($400m^2$).

It is common to arbitrarily classify heart rate intensity ranges to an ordinal set of adjectives such as very light, light, moderate and hard. Castagna et al., (69) for example classified exercise intensity into i) low intensity <70% HRpeak, ii) moderate intensity 70-85% HRpeak, and iii) high intensity >85% HRpeak. Using this classification system for the present study the 7-a-side game and the 15-a-side ($320m^2$) game, were both classified as high intensity activities. The 9-a-side ($300m^2$) game and the 9-a-side game ($400m^2$) were also classified as high intensity activities whereas the 15-a-side game ($400m^2$) was in the moderate intensity zone.

The uptake and transport of oxygen is required for the efficient production of ATP to support the metabolic demands during Gaelic football. Maximal aerobic capacity ($\dot{V}O_2max$) defines the upper limits of the cardiopulmonary system. The ability to sustain a high rate of aerobic energy expenditure during intermittent team sports decreases the reliance on anaerobic glycolysis resulting in a decreased accumulation of lactate in the

exercising muscle (121). The ability to consume oxygen can also enhance recovery from high intensity intermittent exercise by increasing the rate of phosphocreatine resynthesis (122). It is not possible to measure oxygen uptake directly during match play without hindering performance. However, oxygen uptake can be estimated during intermittent team sports based on the $\dot{V}O_2$ and HR relationship obtained during a progressive exercise test (73).

In the present study, the children exercised at a higher %$\dot{V}O_2$max during the 7-a-side game than the 15-a-side game (320m^2). The average % $\dot{V}O_2$max attained during the 15-a-side Gaelic football game (75%) was similar to that reported for soccer (64, 123), whereas the relative oxygen uptake was 86% during the 7-a-side game. There was however no difference in the average %$\dot{V}O_2$max between the two 9-a-side game formats and the 15-a-side (400m^2) games in study 2. It is possible that the number of players on a team may effect the physiological responses. The different findings may be due in part to the number of players selected on a team.

In the present study the $\dot{V}O_2$ and HR relationship obtained during a progressive laboratory based treadmill test was used to estimate $\dot{V}O_2$ during the games in study 1 and study 2. The mean Pearson's product-moment correlation coefficient for the subjects in study 1 and study 2 was 0.96 and 0.93 respectively. Although the Pearson's product-moment correlation coefficient values obtained for each individual $\dot{V}O_2$/HR relationship ranged from 0.94 to 0.97 in study 1, and 0.80 to 0.98 in study 2, the major drawback is that it assumes that the $\dot{V}O_2$ estimations are based on steady state heart rate values (124).

6.4 Enjoyment

Sport enjoyment is defined as a positive affective response to the sport experience that reflects generalised feelings such as pleasure, and fun (87). Sport enjoyment has been shown to be important to motivation in youth sport (4, 83). Studies involving children consistently show that the desire for enjoyment is a major reason given for initial and continued participation in sport, and the lack of enjoyment is cited as the main factor influencing the withdrawal or drop out from sport (4, 84, 85, 86). Fostering mastery experiences and self-set goals are ways to enhance sport enjoyment (7, 8). Conversely Scanlan and Lewthwaite (1986) found that wrestlers who perceived themselves high in ability, experienced more enjoyment than peers low in perceived ability. The present study is the first to compare enjoyment levels during small sided Gaelic football games and full sided (15-a-side) games.

Enjoyment levels were significantly higher in the 7-a-side game than the 15-a-side ($320m^2$) game in the first study. Inclusiveness and the need to feel they have a role to play are key determinants of enjoyment in sport among young people (9). Enjoyment is therefore enhanced through player participation, by providing opportunities to learn and develop skills and to test these skills in a competitive, yet non judgmental environment. The fact that players in the 7-a-side game had a higher number of touches than players in the 15-a-side ($320m^2$) game indicates a greater involvement in the small sided game. The higher % heart rate max and estimated % $\dot{V}O_2$max in the same 7 players during the 7-a-side game than the 15-a-side ($320m^2$) game is further evidence of greater involvement in

the small sided game. These findings suggest that the greater player involvement may be responsible for the significantly higher enjoyment levels in the small sided 7-a-side game.

In contrast, there was no significant difference in enjoyment levels between the 9-a-side games (300m^2 and 400m^2) and the 15-a-side (400m^2) games despite the fact that the number of skills performed, possession characteristics and physiological responses were similar in both the 7-a-side game and 9-a-side games. These results indicate that in terms of enjoyment the 7-a-side game is more suitable than either 9-a-side or 15-a-side game formats in 14 year old boys. It should be noted that the enjoyment levels for both 9-a-side game formats were based on the average of 3 games. In contrast, the levels of enjoyment in study 1 were based on a single 7-a-side game.

It was hypothesized that enjoyment values would also be higher in the 9 a-side games than the official 15-a-side game. Relatively high mean values for enjoyment were recorded in the 15-a-side games in the second study 16.3 (81.5%) of a possible maximum score of 20. This may account for the fact that there was no significant difference between the 15-a-side games and the 9-a-side games. The enjoyment scores in the 15-a-side games may have been influenced by the fact that they were official competitive games, played in front of family and friends. It is also possible that the opportunity to play for their local team in a county competition compared to an arranged small sided game where less importance was placed on the outcome may also help to explain the relatively high enjoyment scores in the 15-a-side games. The enjoyment levels were similar in both 9-a-side game formats and the 15-a-side (400m^2) games despite the fact that the small sided games were played in a more informal environment. It is possible that the

enjoyment scores may have been lower if the 15-a-side games had been played in the same informal environment as the arranged small sided games.

When this study was undertaken, inter club Gaelic football competitions for 10 year olds normally involved playing 15-a-side games. During the course of the study the GAA introduced a modified version of Gaelic Football called Go Games that are now compulsory for children ≤ 12 years of age. The Go Games are played on smaller pitches with fewer players on each team, and modified equipment. The GAA developed these games as a framework and clubs were encouraged to modify the games in line with the overall Go Games philosophy.

In the final study involving 10 year old boys, it was decided to keep both the player numbers and the pitch dimensions constant but to modify the rules. In addition to playing the National Go Games the children also played i) a modified version of the National Go Games utilised by the Dublin County Board, ii) a 9-a-side game played under normal rules, iii) 9-a-side modified game where players were restricted to two touches and iv) a 15-a-side game using normal rules. The field dimensions for the 15-a-side game were modified to insure that the surface area per player was the same as the small sided games.

There was no significant difference in the levels of enjoyment and perceived competence between any of the Go Games and the 15-a-side game. The significantly higher levels of enjoyment in the normal 9-a-side game and the Dublin Go Game compared with the National Go Game may be due in part to the zonal system deployed in the Go Games. With the exception of the two mid-fielders, the zonal system restricts

players to specific zones on the field which may decrease their involvement, and subsequently their enjoyment. The restriction on player movement imposed by the National Go Games makes this game format very different to the traditional game which is extremely fluent whereby players on gaining possession of the ball move smoothly and rapidly from a defensive into an attacking role and vice versa.

6.5 Perceived Competence

Perceived competence in sport can be defined as a individuals belief concerning how capable or competent he/she is at a particular sport (5). Contrary to what was hypothesised, no difference was found in the levels of perceived competence in boys between the age of 10 and 14 years following their participation in small sided games and 15-a-side games. The fact that children's perceptions of competence change both quantitatively and qualitatively during the childhood and adolescent years (5, 7, 8) may help to explain why there was no significant difference in perceptions of confidence following their participation in small sided games and 15-a-side games. These changes are caused not only by age related maturation in relation to physical, cognitive and emotional capabilities, but are also due to changes in the sport environment and the broader social environment. Since children at about 12 years of age begin to distinguish between effort and competence (97), it is likely that the 14 year old boys in this study were able to objectively judge their own level of capability and domain competence in relation to that of their peers, team mates and opponents. In such circumstances it is unlikely they would form or change their perception of competence based on performance in a relatively small number of small sided games over an 8 week period.

In contrast, children up to the age of 12 years tend to have high perceptions of competence due in part to an immature conception of ability (94). Children in this age group are not cognitively mature enough to differentiate effort and ability. The number of touches along with the high relative HR and $\dot{V}O_2$ indicates that effort was a common feature of all games in this study. These factors allied to the age related tendency to over estimate ability may explain the high perceptions of competence among the 10 year olds.

Various studies have reported a positive relationship between high levels of perceived competence and high levels of enjoyment (8, 83, 85, 88). The 12 and 14 year old boys in the present study reported high levels of perceived competence ranging from 78 - 83% for small sided and 15-a-side games. The fact that perceived competence can influence and be influenced by feelings of enjoyment are reflected in the corresponding high levels of enjoyment ranging from 85-96% and 75-85% in the small sided and 15-a-side games respectively. These high levels of enjoyment may help to explain the high levels of perceived competence experienced by the 14 year old children in this study.

Despite the fact that the young players enjoyed playing in the small sided games as much as the full 15-a-side competitive games, and felt equally competent in both formats, the results did not support our hypothesis that the levels of enjoyment and perceived competence would be higher in the small sided games. It is possible that the questionnaire lacked the specificity required to ascertain the participants` preference in terms of which game format they enjoyed most. Future studies should include more direct questions such as " Did you enjoy playing in this game format more than the full sided game," Which of the games would you best like to play on a weekly basis" etc.

Regardless, the overall results indicate that for young players, small sided games are more appropriate than the adult 15 a-side game format to learn and develop the technical and tactical skills of Gaelic football in an enjoyable environment while also experiencing a physiological stimulus appropriate to their maturational stage.

6.6 Study Limitations

1. The questionnaire may not have been sensitive enough to pick up changes in levels of enjoyment and perceived competence in children between the 10-14 year of age

2. Oxygen uptake was estimated and not directly measured during the individual games

3. The study design did not control for biological age

4. The comparisons in study 3 were based on a single game

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The results indicate that small sided games involving fewer players on smaller sized playing areas are a viable alternative to the adult format 15-a-side game. A unique aspect of the present study is that the playing areas in the small sided games were modified to ensure that the surface area available to each player was relative to the 15-a-side games. There is however no consensus on the most appropriate playing area for a given number of players. It is likely that this may vary depending on the outcome measure, e.g., technical skills performed, possession characteristics, physiological responses, and levels of enjoyment and perceived competence.

The small sided games and 15-a-side games in the first two studies were played under normal Gaelic football rules using standard equipment (footballs, goalposts). Future studies should examine how altering the number of players, the playing rules and dimensions of the playing area independently, or in combination with other factors such as playing equipment and game duration alters the dynamics of both the small sided and adult format games in children of different ages and levels of maturity.

In Gaelic football, the relationship between a player and the situation around him/her is dynamic. Skills are performed under the conditions of an unpredictable constantly changing environment that require a considerable amount of contextual processing. Ideally, skills should emerge in and around a “game” environment. Small sided games have been advocated on the basis that the technical and tactical skills are

developed under similar conditions to those encountered during adult games, and therefore are more likely to transfer to the adult game format. Appropriately structured small sided games may also provide young players with the opportunity to develop decision-making and problem solving skills. A comprehensive series of longitudinal studies will be required to examine how decision-making, problem solving and technical and tactical skills that are developed in different small sided game formats in children of different ages and levels of maturity will transfer to the adult game format.

From a physiological perspective, small sided games may also closely simulate the movement patterns and physiological demands of the adult competitive environment. Surprisingly, few studies have systematically examined the activity profiles and physiological responses during small sided games. This is due in large part to the fact that until quite recently the availability of technology for in situ monitoring during sport has been limited.

The availability of low-cost telemetry systems has led to the wide-spread use of heart rate to monitor the physiological responses during team sports involving intermittent activity. This information is sometimes complemented with information on activity patterns using notational analysis. However, notational analysis systems are largely dependent on trained users, and considerable subjectivity may exist when interpreting data. Therefore, accurate performance assessment may be technically difficult given the complex interactions of players and the varied nature of game play.

The increasing availability of sensor technology, in particular the development of unobtrusive sensing elements embedded in the fabric of garments, has opened countless

possibilities of innocuous monitoring over extended periods of time in a variety of sport settings. These new developments combining functional clothing and integrated electronics opens a new research area and possibilities for body sensing during small sided games and communicating physiological parameters such as heart rate, respiratory rate, temperature and sweat rate and composition. In addition, the development of relatively inexpensive accelerometers and global positioning system (GPS) technology for use in sport will permit quantitative measurement of activity profiles through traditional GPS triangulation methods and accessory accelerometer software. This technology will allow investigators to gain information on activity patterns and physiological responses during a variety of small sided game formats.

It is well established that enjoyment and perceived competence in the sports domain can influence continued sport participation and the quality of sport participation. It is possible that the enjoyment scores may have been lower during the 15-a-side games if they had been played in the same informal environment as the arranged small sided games. Considering that small sided Go Games are now compulsory for children ≤ 12 years of age, it would be interesting to compare enjoyment levels in prepubescent players during Go Games and 15-a-side games 3 to 5 years after their formal introduction. The inability of children under the age of 12 years to differentiate effort and ability will require the development of a more sensitive questionnaire to evaluate this construct in this age cohort. In contrast, since children can begin to distinguish between effort and competence at about 12 years of age, it is unlikely they would form or change their perception of competence based on performance in a relatively small number of small

sided games over an 8 week period. Future studies using a longitudinal design will be required to evaluate the impact of small sided games on perceived competence in children older than 12 years of age.

References

(1) Reilly T, Doran D. Science and Gaelic football: A review. J.Sports Sci. 2001 03;19(3):181-193.

(2) Malina RM, Cumming SP, Kontos AP, Eisenmann JC, Ribeiro B, Aroso J. Maturity-associated variation in sport-specific skills of youth soccer players aged 13 - 15 years. J.Sports Sci. 2005 05;23(5):515-522.

(3) Ebbeck V, Weiss M. Determinants of Children's Self-Esteem: An Examination of Perceived Competence and Affect in Sport. Pediatric Exercise Science 1998;10(3):285-298.

(4) Scanlan TK, Simons JP. The Construct of Sport Enjoyment. In: Roberts GC, editor. Motivation in sport and exercise United States: Human Kinetics; 1992. p. 199-215.

(5) Horn TS, Harris A. Perceived competence in young athletes: research findings and recommendations for coaches and parents. In: Smoll FL, Smith RE, editors. Children and youth in sport: a biopsychosocial perspective. 2nd ed. Dubuque, IA, USA: Kendall/Hunt; 2002. p. 435-464.

(6) Crocker PRE, Eklund RC, Kowalski KC. Children's physical activity and physical self-perceptions. J.Sports Sci. 2000 06;18(6):383-394.

(7) Weiss MR, Ebbeck V. Self-esteem and perceptions of competence in youth sports: theory, research and enhancement strategies. In: Bar-Or O, editor. The child and adolescent athlete: The Encyclopedia of Sports Medicine, Volume VI. United States: Blackwell Scientific Publications; 1996. p. 364-382.

(8) Weiss MR, Kimmel LA, Smith AL. Determinants of Sport Commitment Among Junior Tennis Players: Enjoyment as a Mediating Variable. Pediatric Exercise Science 2001 05;13(2):131.

(9) MacPhail A, Kirk D, Eley D. Listening to young people's voices: youth sports leaders' advice on facilitating participation in sport. European Physical Education Review 2003 02;9(1):57-73.

(10) MacPhail A, Kinchin G, Kirk D. Students' conceptions of sport and sport education. European Physical Education Review 2003 10;9(3):285-299.

(11) Sassi A, Reilly T, Impellizzeri F. A Comparison of Small-Sided Games and Interval Training in Elite Professional Soccer Players. In: Reilly T, Cabri J, Araújo D, editors. Science and Football V: proceedings of the fifth world congress on science and football London: Routledge; 2005. p. 341-343.

(12) Reilly T, White C. Small-Sided Games as an Alternative to Interval-Training for Soccer Players. In: Reilly T, Cabri J, Araújo D, editors. Science and Football V: proceedings of the fifth world congress on science and football London: Routledge; 2005. p. 344-347.

(13) Grant A, Williams M, Dodd R, Johnson S. Physiological and Technical Analysis of 11 v 11 and 8 v8 Youth Football Matches. Insight (FA Coaches Association Journal 1999a;3(2):29-30.

(14) Grant A, Williams M, Johnson S. Technical Demands of 7 v 7 and 11 v 11 Youth Football Matches. Insight (FA Coaches Association Journal 1999b;3(4):26-27.

(15) Platt D, Maxwell A, Horn R, Williams M, Reilly T. Physiological and technical analysis of 3v3 and 5v5 youth football matches. Insight 2001;4:23-25.

(16) Williams K, Owen A. The impact of player numbers on the physiological responses to small sided games. Journal of Sports Science and Medicine 2007;6(Supplement 10):100.

(17) Little T, Williams AG. Measures of exercise intensity during soccer training drills with professional soccer players. J.Strength Cond Res. 2007 May;21(2):367-371.

(18) Raab M. Decision Making in Sports: Influence of Complexity on Implicit and Explicit Learning. International Journal of Sport & Exercise Psychology 2003 12;1(4):406-433.

(19) Raab M, Johnson JG. Implicit Learning as a Means to Intuitive Decision Making in Sports. In Intuition in Judgment and Decision Making. In: Plessner H, Betch C, Betch T, editors. New York: Taylor and Francis; 2008. p. 119-133.

(20) Williams AM, Hodges NJ. Practice, instruction and skill acquisition in soccer: Challenging tradition. J.Sports Sci. 2005;23(6):637.

(21) Abernethy B, Baker J, Cote J. Transfer of Pattern Recall Skills as a contributor to the development of Sport Expertise. Applied Cognitive Psychology 2005;19:705-718.

(22) Farrow D, Raab M. A Recipe for expert decision making. In: Farrow D, Baker J, MacMahon C, editors. Developing Sport Expertise: Researchers and Coaches Put Theory Into Practice London and New York: Routledge, Taylor and Francis Group; 2008. p. 137-154.

(23) Berry J, Abernethy B, Côté J. The Contribution of Structured Activity and Deliberate Play to the Development of Expert Perceptual and Decision-Making Skill. J.Sport Exercise Psychol. 2008 12;30(6):685-708.

(24) Vaeyens R, Philippaerts RM, Williams AM. Mechanisms Underpinning Successful Decision Making in Skilled Youth Soccer Players: An Analysis of Visual Search Behaviors. Journal of Motor Behavior 2007;39(5):395-406.

(25) Daly P. Otu Games Developmental Model-Underpinning the GAA Grassroots to National Programme. 2004a.

(26) Daly P. "Go Games"-Part of the GAA Grassroots to National Programme (GNP),supported by the Irish Sports Council. 2004b.

(27) Gaelic Athletic Association. Annual Report 2010 Part 1. 2010; Available at: http://www.gaa.ie/content/documents/publications/annual_reports/Annual_Report_2010_Part1_Pg1_51.pdf. Accessed 09/24, 2010.

(28) Malina RM, Reyes MEP, Eisenmann JC, Horta L, Rodrigues J, Miller R. Height, mass and skeletal maturity of elite Portuguese soccer players aged 11–16 years. J.Sports Sci. 2000;18(9):685.

(29) Helsen WF, Van Winckel J, Williams M. The relative age effect in youth soccer across Europe. Journal of Sports Sciences 2005;23(6):629-636.

(30) Kraemer WJ, Fleck SJ. Strength training for young athletes. Champaign, IL, USA: Human Kinetics; 1993.

(31) Malina RM, Bouchard C, Bar-Or O. Growth, maturation, and physical activity. 2nd ed. Champaign, Ill.; United States: Human Kinetics; 2004.

(32) Tanner JM. Growth at Adolescence. 2nd ed. Oxford, UK: Blackwell; 1962.

(33) Tanner JM, Davies PSW. Clinical longitudinal standards for height and height velocity for North American children. J Pediatr. 1985 09/01;107(3):317-329.

(34) Helsen WF, Hodges NJ, Van Winckel J, Starkes JL. The roles of talent, physical precocity and practice in the development of soccer expertise. J.Sports Sci. 2000;18(9):727.

(35) Vincent J, Glamser FD. Differences in the relative age effect among US Olympic Development Program youth soccer players. Journal of Sports Sciences 2006;24(4):405-413.

(36) Malina RM, Ribeiro B, Aroso J, Cumming SP. Characteristics of youth soccer players aged 13-15 years classified by skill level. Br.J.Sports Med. 2007 05;41(5):290-295.

(37) Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccer. J.Sports Sci. 2000;18(9):669.

(38) Bigelow EW. School progress of under-age children. ESJ 1934;35(3):186-192.

(39) Uphoff JK, Gilmore J. Viewpoint 2. Pupil Age at School Entrance: How Many are Ready for Success? Young Children 1986;41(2):11-16.

(40) Barnsley, R. H., Thompson, A. H. and Barnsley, P. E. Hockey success and birthdate: The relative age effect. CAHPER 1985;53:21-24.

(41) Barnsley RH, Thompson AH. Birthdate and success in minor hockey. Canadian Journal of Behavioral Science 1988;20:167-176.

(42) Barnsley RH, Thompson AH, Legault P. Family Planning: Football Style. The Relative Age Effect in Football. Int Rev Sociol Sport 1992 March 01;27(1):77-87.

(43) Thompson AH, Barnsley RH, Stebelsky G. Born to Play Ball: The Relative Age Effect and Major League Baseball. Sociol Sport J 1991;88(2):146-151.

(44) Boucher JL, Mutimer BT. The relative age phenomenon in sport: a replication and extension with ice-hockey players. Res Q Exercise Sport 1994 Dec;65(4):377-381.

(45) Dudink AD. Birth date and sporting success. Nature 1994 04/14;368(6472):592.

(46) Brewer J, Balsom P, Davis J. Seasonal distribution amongst European soccer players. Sports Exerc Injury 1995;1:154-157.

(47) Verhulst J. Seasonal birth distribution of west European soccer players: a possible explanation. Med Hypotheses 1992 Aug;38(4):346-348.

(48) Musch J, and Grondin S. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. Developmental Review. Developmental Review 2001;21:147-167.

(49) Reilly T, Williams AM, Nevill A, Franks A. A multidisciplinary approach to talent identification in soccer. J.Sports Sci. 2000;18(9):695.

(50) Williams AM, Reilly T. Talent identification and development in soccer. J.Sports Sci. 2000;18(9):657.

(51) Simmons C, Paull GC. Season-of-birth bias in association football. J Sports Sci 2001;19(9):677-686.

(52) Potential problems and pitfalls in identifying future elite performers. World Commission of Science and Sports and the F.A. Coaches Association; 2003.

(53) Vaeyens R, Lenoir M, Williams AM, Philippaerts RM. Talent Identification and Development Programmes in Sport: Current Models and Future Directions. Sports Medicine 2008 09;38(9):703.

(54) Vaeyens R, Philippaerts RM, Malina RM. The relative age effect in soccer: A match-related perspective. Journal of sports sciences 2005;23(7):747-756.

(55) Hill-Haas SV, Dawson BT, Coutts AJ, Rowsell GJ. Physiological responses and time–motion characteristics of various small-sided soccer games in youth players. J.Sports Sci. 2009a;27(1):1.

(56) Fraser-Thomas J, Cote J. Youth Sports: Implementing Findings and Moving Forward with Research. Athletic Insight: The Online Journal of Sport Psychology 2006;8(3):12-27.

(57) Baker J, Cote J, Abernethy B. Sport-Specific Practice and the Development of Expert Decision-Making in Team Ball Sports. Journal of Applied Sport Psychology 2010;15(1):12-25.

(58) Bangsbo J. Physiology of Training. In: Reilly T, Williams AM, editors. Science and Soccer. 2nd ed. London: Routledge; 2003. p. 47-58.

(59) Capranica L, Tessitore A, Guidetti L, Figura F. Heart rate and match analysis in pre-pubescent soccer players. J.Sports Sci. 2001 06;19(6):379-384.

(60) Jones S, Drust B. Physiological and technical demands of 4v4 and 8v8 games in elite youth soccer players. Kinesiology 2007;39(2):150-156.

(61) Kelly DM, Drust B. The effect of pitch dimensions on heart rate responses and technical demands of small-sided soccer games in elite players. J.Sci.Med.Sport 2009 Mar 18.

(62) Katis A, Kellis E. Effects of small-sided games on physical conditioning and performance in young soccer players. J Sports Sci Med 2009;8:374-380.

(63) Rampinini E, Impellizzeri FM, Castagna C, Abt G, Chamari K, Sassi A, et al. Factors influencing physiological responses to small-sided soccer games. J.Sports Sci. 2007 04;25(6):659-666.

(64) Reilly T. Motion analysis and physiological demands. In: Reilly T, editor. Science and Soccer United Kingdom: E & FN Spon; 1996. p. 65-81.

(65) Reilly T, Vaughan T. A motion analysis of work-rate in different positional roles in professional football match-play. Journal of Human Movement Studies 1976;2:87-97.

(66) American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. Philidelphia, Pennsylvania: Lippincott williams and wilkins; 2007.

(67) Castagna C, D'Ottavio S, Abt G. Activity Profile of Young Soccer Players During Actual Match Play. Journal of Strength and Conditioning Research 2003;17(4):775-780.

(68) Billows D, Reilly T, George K. Physiological Demands of Match Play and Training in Elite Adolescent Footballers. In: Reilly T, Cabri J, Araújo D, editors. Science and Football V: proceedings of the fifth world congress on science and football London: Routledge; 2005. p. 453-461.

(69) Castagna C, Belardinelli R, Impellizzeri F, Abt G, Coutts A, D'Ottavio S. Cardiovascular responses during recreational 5-a-side indoor-soccer. Journal of Science & Medicine in Sport 2007 04;10(2):89-95.

(70) Owen A, Twist C, Ford P. Small-sided games: The physiological and technical effect of altering pitch size and player numbers. Insight 2004;7:50-53.

(71) Reilly T. Science and football: A history and an update. In: T. Reilly,J. Cabri, & D. Araujo, editor. Science and football V London: Routledge; 2005. p. 3-12.

(72) Hoff J, Helgerud J. Endurance and strength training for soccer players: physiological considerations. Sports Med. 2004;34(3):165-180.

(73) Esposito F, Impellizzeri FM, Margonato V, Vanni R, Pizzini G, Veicsteinas A. Validity of heart rate as an indicator of aerobic demand during soccer activities in amateur soccer players. Eur.J.Appl.Physiol. 2004 Oct;93(1-2):167-172.

(74) Hoff J, Wisloff U, Engen LC, Kemi OJ, Helgerud J. Soccer specific aerobic endurance training. Br.J.Sports Med. 2002 06;36(3):218-221.

(75) Drust B, Reilly T, Cable NT. Physiological responses to laboratory-based soccer-specific intermittent and continuous exercise. J.Sports Sci. 2000 11;18(11):885-892.

(76) Rohde HC, Espersen T. Work intensity during soccer training and match-play. In: Reilly T, Lees A, Davids K, editors. Science and Football London: E&FN Spon; 1988. p. 68-75.

(77) Stølen T, Chamari K, Castagna C, Wisløff U, Physiology of soccer: an update. Sports Med. 35(6):501-36, 2005. Physiology of soccer: an update. Sports Med. 2005;35(6):501-536.

(78) Castagna C, Belardinelli R, Abt G. The VO_2 and HR response to Training with a Ball in Youth Soccer Players. In: Reilly T, Cabri J, Araújo D, editors. Science and Football V: proceedings of the fifth world congress on science and football London: Routledge; 2005. p. 462-464.

(79) Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. J.Pediatr. 2005 Jun;146(6):732-737.

(80) Trost SG, Pate RR, Saunders R, Ward DS, Dowda M, Felton G. A prospective study of the determinants of physical activity in rural fifth-grade children. Prev.Med. 1997 Mar;26(2):257-263.

(81) Kirk D. Physical education,youth sport and lifelong participation: The importance of early learning experiences. European Physical Education Review 2005(11):239-255.

(82) Ferrer-Caja E, Weiss MR. Predictors of intrinsic motivation among adolescent students in physical education. Res.Q.Exerc.Sport 2000 Sep;71(3):267-279.

(83) Scanlan TK, Lewthwaite R. Social psychological aspects of competition for male youth sport participants: IV. Predictors of enjoyment. Journal of Sport Psychology 1986;8:25-35.

(84) Bengoechea EG, Strean W, Williams DJ. Understanding and promoting fun in youth sport: coaches' perspectives. Physical Education & Sport Pedagogy 2004 11;9(2):197-214.

(85) Siedentop D. Junior sport and the evolution of sport cultures. Journal of Teaching in Physical Education 2002 07;21(4):392-401.

(86) Wankel LM, Kreisel PSJ. Factors underlying enjoyment of youth sports: sport and age group comparisons. Journal of Sport Psychology 1985 03;7(1):51-64.

(87) Scanlan TK, Carpenter PJ, Schmidt GW, Simons JP, Keeler B. An Introduction to the port Commitment Model. J.Sport Exercise Psychol. 1993 03;15(1):1-15.

(88) Scanlan TK, Simons JP, Carpenter PJ, Schmidt GW, Keeler B. The Sport Commitment Model: Measurement Development for the Youth-Sport Domain. J.Sport Exercise Psychol. 1993 03;15(1):16-38.

(89) Carpenter PJ, Scanlan TK. Changes Over Time in the Determinants of Sport Commitment. Pediatric Exercise Science 1998 11;10(4):356-365.

(90) Simons-Morton B, McKenzie TJ, Stone E, Mitchell P, Osganian V, Strikmiller PK, et al. Physical Activity in a Multiethnic Population of Third Graders in Four States. Am.J.Public Health 1997 01;87(1):45-50.

(91) Pate RR, Trost SG, Felton GM, Ward DS, Dowda M, Saunders R. Correlates of physical activity behavior in rural youth. Research Quarterly for Exercise & Sport 1997 09;68(3):241-248.

(92) Rudisill M. The influence of various achievement goal orientations on perceived competence and the attributional process. Journal of Human Movement Studies 1989;16(2):55-73.

(93) McCarthy PJ, Jones MV, Clark-Carter D. Understanding enjoyment in youth sport: A developmental perspective. Psychol.Sport Exerc. 2008 3;9(2):142-156.

(94) Nicholls JG. The Development of the Concepts of Effort and Ability, Perception of Academic Attainment, and the Understanding that Difficult Tasks Require More Ability. Child Development 1978 00/00;49(3):800-14.

(95) Kavussanu M, Harnisch DL. Self-esteem in children: Do goal orientations matter? Br.J.Educ.Psychol. 2000 06;70(2):229-242.

(96) Ntoumanis N. Empirical links between achievement goal theory and self-determination theory in sport. J.Sports Sci. 2001 06;19(6):397-409.

(97) Nicholls JG. Achievement Motivation: Conceptions of Ability, Subjective Experience, Task Choice, and Performance. Psychological Review 1984 00/00;91(3):328-46.

(98) Deci EL, Ryan RM. Intrinsic Motivation and Self-Determination in Human Behavior. New Work: Plenum Press; 1985.

(99) Deci EL, Vallerand RJ, Pelletier LG, Ryan RM. Motivation and Education: The Self-Determination Perspective. Educational Psychologist 1991;26(3):325.

(100) Biddle S, Cury F, Goudas M, Sarrazin P, Famose JP, Durand M. Development of scales to measure perceived physical education class climate: a cross-national project. Br.J.Educ.Psychol. 1995 Sep;65:341-358.

(101) Goudas M, Biddle S. Perceived Motivational Climate and Intrinsic Motivation in School Physical Education Classes. European Journal of Psychology of Education 1994;9(3):241-250.

(102) Theeboom M, De Knop P. Motivational Climate, Psychological Responses, and Motor Skill Development in Children's Sport: A Field-Based Intervention Study. J.Sport Exercise Psychol. 1995 09;17(3):294-311.

(103) Harter S. Effectance motivation reconsidered: Toward a developmental model. Human Development 1978;21(1):34-64.

(104) Nicholls JG. The competitive ethos and democratic education. Cambridge, MA ed.: Harvard University Press; 1989.

(105) Malina RM. Youth Football Players: Number of Participants, Growth and Maturity Status. In: Reilly T, Cabri J, Araújo D, editors. Science and Football V: proceedings of the fifth world congress on science and football London: Routledge; 2005. p. 419-427.

(106) Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Stillman RJ, Van Loan MD, et al. Skinfold Equations for Estimation of Body Fatness in Children and Youth. Human Biology 1988;60(5):709-723.

(107) Carpenter PJ, Scanlan TK, Simons JP, Lobel M. A Test of the Sport Commitment Model Using Structural Equation Modeling. Journal of Sport & Exercise Psychology 1993;15:119-133.

(108) Eccles J, Wigfield A, Harold R, Blumenfeld P. Age and Gender Differences in Children's Self- and Task Perceptions during Elementary School. Child Development 1993;64:830-847.

(109) Jacobs JE, Lanza S, Osgood DW, Eccles JS, Wigfield A. Changes in Children's Self-Competence and Values: Gender and Domain Differences across Grades One through Twelve. Child Development 2002;73(2):509-527.

(110) Schmidt RA. A Schema Theory of Discrete Motor Skill Learning. Psychological review 1975(83):225-260.

(111) Schmidt RA. Motor Schema Theory after 27 Years : Reflections and Implications for a New Theory. Research Quarterly for Exercise & Sport 2003;74(4):366-375.

(112) Schmidt RA, Lee TD. Motor Control and Learning: A Behavioral Emphasis (4th Ed.). Champaign IL: Human Kinetics; 2005.

(113) Schmidt RA, Wrisberg CA. Motor Learning and Performance : A situation-Based Learning Approach; Fourth Edition. Champaign, IL: Human Kinetics; 2008.

(114) Magill RA. Motor Learning and Control:Concepts and Applications 7th Edition. New York: McGraw-Hill; 2003.

(115) Magill RA. Motor Learning and Control: Concepts and Applications Eight Edition. New York: McGraw-Hill,; 2007.

(116) Bangsbo J, Mohr M, Krustrup P. Physical and metabolic demands of training and match-play in the elite football player. J.Sports Sci. 2006 07;24(7):665-674.

(117) Reilly T. Energetics of high-intensity exercise (soccer) with particular reference to fatigue. Journal of Sports Sciences 1997(15):257-273.

(118) Coutts A, reaburn P, and Grant A. Heart rate, blood lactate concentration and estimated energy expenditure in a semi-professional rugby league team during a match: a case study. Journal of sports sciences 2003(21):97-103.

(119) Coutts AJ, Rampinini E, Marcora SM, Castagna C, Impellizzeri FM. Heart rate and blood lactate correlates of perceived exertion during small-sided soccer games. Journal of Science & Medicine in Sport 2009 01;12(1):79-84.

(120) Reilly T, Keane S. Estimation of physiological strain on Gaelic football players during match play. In: W. Spinks, T. Reilly A. Murphy, editor. Science and Football 1V London: Routledge; 2002. p. 157-159.

(121) Glaister M. Multiple sprint work: Physiological responses, mechanisms of fatigue and the influence of aerobic fitness. Sports Med. 2005;35(9):757-777.

(122) Harris RC, Edwards RH, Hultman E, Nordesjo l-, Nylind B, Sahlin K. The time course of phosphorylcreatine resynthesis during recovery of the quadriceps muscle in man. Pflugers Arch 1976(367):137-142.

(123) Bangsbo J. Fitness Training in Football: A Scientific Approach. Copenhagen University: August Krogh Institute; 1994.

(124) Astrand PO, & Rodahl K. Textbook of work physiology. New York: McGraw-Hill; 1986.

APPENDIX 1

General Health Questionnaire

School Of Health and Human Performance
Dublin City University

General Health Questionnaire

Child's name:.....

Address:.....

Telephone: (Home).....

Does your child have, or has your child ever suffered from: -Diabetes? Yes / No

-Asthma? Yes / No

-Epilepsy? Yes / No

Has your child ever had pains in your chest or heart? Yes / No

Does your child ever feel faint or have spells of dizziness? Yes / No

Does your child have or has your child ever had high blood pressure? Yes / No

Does your child have a muscle, back or joint problem that could be aggravated by physical activity or made worse with exercise? Yes / No

Does your child have any current injuries? Yes / No

In the past week, has your child suffered from any illness which required your child to be in bed or off school for one day or more? Yes / No

Is there a good physical reason not mentioned here why your child should not carry out this study? Yes / No

Please provide any further information concerning any condition/complaints which your child suffers from and any medication which your child may be taking by prescription or otherwise:

.....

.....

.....

Date: Signature:

Authorising Signature:

Questionnaire to Assess Enjoyment and Perceived Competence

Date of birth _____ Code_____

1) Think about the gaelic football match you just played and then please answer the following items honestly and carefully

Part 1

	Very much	Pretty much	Sort of	A little	Not at all
1. Did you enjoy playing in the match?	5	4	3	2	1
2. Were you happy playing in the match?	5	4	3	2	1
3. Did you have fun playing in the match?	5	4	3	2	1
4. Did you like playing in the match?	5	4	3	2	1

Part 2

	Very good	Mostly good	Sometimes good	About average	Sometimes not good	Mostly not good	Not at all good
1. How good were you at gaelic football during this game?	7	6	5	4	3	2	1

	The best	One of the best	In the upper half of the team	About average	In the lower half of the team	One of the worst	The worst
2. If you were to rank all of the players on your team on how good they were at gaelic football today where would you put yourself?	7	6	5	4	3	2	1

	A lot better	Mostly better	A little better	Neither better or worse	A little worse	Mostly worse	A lot worse
3. Compared to other things you do, how good are you at gaelic football?	7	6	5	4	3	2	1

	Very good	Mostly good	Sometimes good	Neither good or bad	Sometimes not good	Mostly not good	Not good at all
4. How good would you be at learning something new in football?	7	6	5	4	3	2	1

APPENDIX 2

Study 1

DUBLIN CITY UNIVERSITY

RESEARCH INFORMED CONSENT FORM

I. I _____willingly agree to allow my child_____ to participate in this investigation entitled: Assessment of Physiological Responses and Activity Patterns in Children during Gaelic Football.

II. Introduction to this study:

The principle reason why children take part in sport is to have fun. However, underage Gaelic football competitions are becoming more competitive and less enjoyable. Selection procedures appear to be biased away from skill in favour of physical size. Such practice discourages the ambitions of children who have equal potential to become great players at maturity. There is a need to employ a multifaceted approach to underage competitions during the developmental years. This approach should be based on the premise that all children should be provided equal access and meaningful playing time in a fun-filled environment. The development of conditioned mini-games on appropriate sized playing areas has been advocated as an alternative to the current system.

III. My child is being asked to take part in this research study.

The purpose of this study is to: compare the physiological responses in U-14 players during 15 a-side games and a conditioned mini-game, ii) compare individual involvement in U-14 players during 15 a-side and a conditioned mini-game and, iii) compare levels of enjoyment in U-14 players during 15 a-side and a conditioned mini-game

IV. This research study will take place at the Centre for Sport Science and Health, Dublin City University.

V. This is what will happen during the research study:

1. My child will visit the Centre for Sport Science and Health on 2 separate occasions and play in two 15 a-side Gaelic football games and two 7 a-side Gaelic football games. He will be asked not to undertake any strenuous physical activity for 24 hours and to fast for 4 hours before each laboratory visit and each football game.
2. During the first visit my child will have his height, weight, resting blood pressure and resting heart rate measured. His body fat will be estimated using skinfold calipers. He will then get the chance to become familiar with walking and running on a treadmill. During the treadmill walk/run he will be fitted with a mouthpiece connected to a machine and computer to measure the composition of gases in his breath.
3. During the second visit to DCU my child will have his lung function assessed, and will then perform an exercise test to assess his fitness level. This will involve running on a treadmill until he reaches

his maximal exercise capacity. He will be fitted with a mouthpiece connected to a machine and computer to measure the composition of gases in his breath.

4. My child will have his heart rate measured during two 15 a-side Gaelic football games and two 7 a-side Gaelic football games. Prior to each game he will place a heart rate monitoring device around his chest. The monitor will be removed immediately after each game. The heart rate monitor will automatically record his heart rate during the game. Each game will be recorded on video in order to assess my child's involvement in the game.

VI. <u>Sometimes there are side effects from performing exercise tests. These side effects are often called risks, and for this project, the risks are:</u>

Because my child will be asked to give a maximum effort, he may experience some muscle soreness in his legs, may feel tired or experience nausea for a short time following the test. By following the proper experimental protocol these risks are minimal.

VII. <u>There may be benefits from my child's participation in this study. These</u> are:

I will receive a copy of my child's personal results after the study. No other benefits have been promised to my child.

VIII. <u>My child's confidentiality will be guarded:</u>

Dublin City University will protect all the information about my child and his part in this study. My child will be assigned a personal ID number under which all of his personal details will be stored in a computer. These details will only be accessible to those persons who are directly associated with, or involved in the study. No published documents will link his/her personal information to him.

IX: <u>I know that I am permitted to accompany my child to the test center.</u>

I will not be permitted to stay in the room while the exercise test is being performed as my presence may influence my child's performance. I can stay with my child at all other times.

X: <u>If I have questions about the research project, I am free to call Dr. Niall Moyna at 01-7008802</u>

<u>XI: Taking part in this study is my decision.</u>

If I do agree to allow my child to take part in the study, he may stop at any point, before or during testing, without penalty. However, once testing has been completed I will not be able to withdraw my child's information from the study.

XII. <u>Signature:</u>

I have read and understood the information in this form. The researchers have answered my questions and concerns, and I have a copy of this consent form. Therefore, I consent to allow my child to take part in this research project entitled "Assessment of Physiological Responses and Activity Patterns in Children During Gaelic Football"

Signed: _____

_____ (Printed name)

_____

Witness: _____ (Signature)

Witness: _____ (Printed name)

Study 1

DUBLIN CITY UNIVERSITY

ASSENT FORM FOR CHILDREN

Study Title: Assessment of Physiological Responses and Activity Patterns in Children during Gaelic Football.

1. My parents/guardian and Michael Whelan who is a postgraduate student at Dublin City University (DCU) have talked to me about being part of a research study.
2. I have been told that I will have to visit DCU on two separate days and play in two 15 a-side Gaelic football games and two 7 a-side Gaelic football games.
3. On my first visit to DCU I will have my height, weight, blood pressure and heart rate measured. The amount of fat tissue and muscle in my body will be estimated by taking skinfold measurements using special calipers. I will also be asked to practice walking and running of a treadmill while wearing a nose clip on my nose and a mouthpiece in my mouth.
4. On my second visit to DCU I will perform a test to see how healthy my lungs are. I will be asked to take deep breath in and then blow out the air in my lungs. I will run on treadmill to see how fit I am. I will wear a nose clip on my nose and a mouthpiece in my mouth during the treadmill test.
5. I will have my heart rate measured during a 15 a-side Gaelic football games and a 7 a-side Gaelic football games. Before each game I will have a small device placed around my chest to measure my heart. Each game that I play will be recorded on a video.
6. After each of the games, I will complete a short questionnaire to find out how much I enjoyed the game and what I think about my football ability. It will take about 10 minutes to complete the questionnaire. I will be allowed to ask questions if I do not understand any of the questions.
7. I will not drink any alcohol or eat any food for 4 hours before any of the laboratory tests or games.
8. I will not do any exercise that makes me tired the day before the laboratory tests or games.
9. The clip on my nose and the plastic tube in my mouth may feel a little bit uncomfortable.
10. I will be allowed to stop running whenever I want.
8. I may feel tired or be out of breath when I am running and my legs may feel tired
9. If I wish, I can stop coming to DCU to do the tests at any time. If I wish I may choose not the play in any of the games.
10. I know that I am allowed to ask my parents/guardian to come to DCU with me or to all or any of the football games with me.
11. I know that the people in DCU, my coach and my parents/guardian will not be upset with me if I decide not to take part in this study or if I wish to stop taking part in the study.

SIGNED: _____ DATE: _____
(Participant's name)

SIGNED: _____ DATE: _____
(Witness' name)

Study 2

DUBLIN CITY UNIVERSITY

RESEARCH INFORMED CONSENT FORM

I. I _____willingly agree to allow my child_____ to participate in this investigation entitled:

Assessment of Physiological Responses and Activity Patterns in Children During Gaelic Football.

II. Introduction to this study:

The principle reason why children take part in sport in to have fun. However, underage Gaelic football competitions are becoming more competitive and less enjoyable. Selection procedures appear to be biased away from skill in favour of physical size. Such practice discourages the ambitions of children who have equal potential to become great players at maturity. There is a need to employ a multifaceted approach to underage competitions during the developmental years. This approach should be based on the premise that all children should be provided equal access and meaningful playing time in a fun-filled environment. The development of conditioned mini-games on appropriate sized playing areas has been advocated as an alternative to the current system.

III. My child is being asked to take part in this research study.

The purpose of this study is to: compare the physiological responses in U-14 players during 15 a-side games and small sided games, ii) compare individual involvement in U-14 players during 15 a-side and small sided games and, iii) compare levels of enjoyment in U-14 players during 15 a-side and small sided games

IV. This research study will take place in the School of Health and Human Performance, Dublin City University and Scotstown GAA club, Carrickmacross GAA Club Monaghan Harps GAA club, Castleblaney GAA club, Emyvale GAA club.

V. This is what will happen during the research study:

1. My child will visit the School of Health and Human Performance, DCU on one occasion and play in three official U-14 Monaghan league games and 6 small sided (7 a-side) games. He will be asked not to undertake any strenuous physical activity for 24 hours and to fast for 3 hours before the laboratory visit and each football game.
2. During the visit to the School of Health and Human Performance in DCU, my child will have his height, weight, resting blood pressure and resting heart rate measured. He will then have his lung function assessed, and will then perform an exercise test to assess his fitness level. This will involve running on a treadmill until he reaches his maximal exercise capacity. He will be fitted with a mouthpiece connected to a machine and computer to measure the composition of gases in his breath.
3. My child will have his heart rate measured during three official U-14 league games and six small sided (9-a-side) games. These games will be played among four venues – Scotstown, Carrickmacross, Monaghan, Emyvale and Castleblaney. Prior to each game he will place a heart rate monitoring device around his chest. The monitor will be removed immediately after each game. The heart rate monitor will automatically record his heart rate during the game. Each game will be recorded on video in order to assess my child's involvement in the game.

4. After each of the games, my child will complete a short questionnaire to find out how much he enjoyed the game and what he things about his football ability. It will take about 10 minutes to complete the questionnaire. My child will be allowed to ask questions if he does not understand any of the questions.

VI. Sometimes there are side effects from performing exercise tests. These side effects are often called risks, and for this project, the risks are:

Because my child will be asked to give a maximum effort, he may experience some muscle soreness in his legs, may feel tired or experience nausea for a short time following the test. By following the proper experimental protocol these risks are minimal.

VII. There may be benefits from my child's participation in this study. These are:

I will receive a copy of my child's personal results after the study. No other benefits have been promised to my child.

VIII. My child's confidentiality will be guarded:

Dublin City University will protect all the information about my child and his part in this study. My child will be assigned a personal ID number under which all of his personal details will be stored in a computer. These details will only be accessible to those persons who are directly associated with, or involved in the study. No published documents will link his/her personal information to him.

IX: I know that I am permitted to accompany my child to the test center.

I will not be permitted to stay in the room while the exercise test is being performed as my presence may influence my child's performance. I can stay with my child at all other times.

X: If I have questions about the research project, I am free to call Prof. Niall Moyna at 01-7008802

XI: Taking part in this study is my decision.

If I do agree to allow my child to take part in the study, he may stop at any point, before or during testing, without penalty. However, once testing has been completed I will not be able to withdraw my child's information from the study.

XII. Signature:

I have read and understood the information in this form. The researchers have answered my questions and concerns, and I have a copy of this consent form. Therefore, I consent to allow my child to take part in this research project entitled "Assessment of Physiological Responses and Activity Patterns in Children During Gaelic Football"

Signed: _____

_____
(Printed name)

Date: _____

Witness: _____
(Signature)

Witness: _____
(Printed name)

Study 2

DUBLIN CITY UNIVERSITY

ASSENT

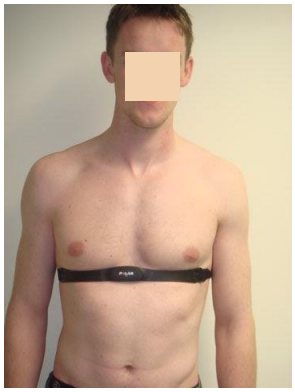
Study Title: Assessment of Physiological Responses and Activity Patterns in Children During Gaelic Football.

My parents/guardian and Michael Whelan who is a postgraduate student at Dublin City University (DCU) have talked to me about being part of a research study.

I have been told that I will visit Dublin City University to have my fitness levels assessed. I will also play in three under-14 league games in Monaghan and six specially organized mall sided games. These small small sided games will be played in local venues.

During my visit to DCU I will have my height, weight, blood pressure and heart rate measured. The amount of fat tissue and muscle in my body will be estimated by taking skinfold measurements using special calipers. I will then perform a test to see how healthy my lungs are. I will be asked to take deep breath in and then blow out the air in my lungs. Finally, I will run on treadmill to see how fit I am. I will wear a nose clip on my nose and a mouthpiece in my mouth during the treadmill test.

I will have my heart rate measured during all the games. Before each game I will have a small strap placed around my chest to measure my heart rate. Each game that I play will be recorded on a video.



After each of the games, I will complete a short questionnaire to find out how much I enjoyed the game and what I think about my football ability. It will take about 10 minutes to complete the questionnaire. I will be allowed to ask questions if I do not understand any of the questions.

I will not eat any food for 3 hours before the laboratory test or games.

I will not do any exercise that makes me tired the day before the laboratory tests or games.

The clip on my nose and the plastic tube in my mouth may feel a little bit uncomfortable.

I will be allowed to stop running whenever I want.

I may feel tired or be out of breath when I am running and my legs may feel tired

If I wish, I can stop coming to DCU to do the tests at any time. If I wish I may choose not the play in any of the games.

I know that I am allowed to ask my parents/guardian to come to DCU with me or to all or any of the football games with me.

I know that the people in DCU, my coach and my parents/guardian will not be upset with me if I decide not to take part in this study or if I wish to stop taking part in the study.

SIGNED: _____ DATE: _____(Participant's name)

SIGNED: _____ DATE: _____

(Witness' name)

Study 3

DUBLIN CITY UNIVERSITY

Plain Language Statement

I. Introduction to the Research Study

Effect of mini-games on physiological responses, skill performance, perceived competence and enjoyment in children

The School of Health and Human Performance.

Prof. Niall Moyna niall.moyna@dcu.ie
Michael Whelan michaelbwhelan@hotmail.com

II. Details of what involvement in the Research Study will require

You will be asked to play 5 matches, two Go Games, one 9 a-side regular game, one regular 15 a-side game and one modified 9 a-side game. These rules will be explained to you before starting. We will be making a videotape of each game and we will use this video to examine the games. You will wear a strap that records your heart rate throughout both games. After each game, you will be asked to fill out a short questionnaire. It will ask you questions about the game and how you felt while playing it.

III. Potential risks to participants from involvement in the Research Study (if greater than that encountered in everyday life)

This game will be no different to any other game of football that you have already played with your club. Therefore similar risks are involved.

IV. Benefits (direct or indirect) to participants from involvement in the Research Study

V. Advice as to arrangements to be made to protect confidentiality of data, including that confidentiality of information provided is subject to legal limitations

Each name will be given a number; this means that nobody will know your details and confidentiality will be secure.

VI. Advice as to whether or not data is to be destroyed after a minimum period

VII. Statement that involvement in the Research Study is voluntary

You can withdraw from the study at any time if you wish. There will be no penalty for withdrawing before all stages of the Research Study have been completed.

If participants have concerns about this study and wish to contact an independent person,please contact:

The Secretary, Dublin City University Research Ethics Committee, c/o Office of the Vice-President for Research, Dublin City University, Dublin 9. Tel 01-7008000

Study 3

DUBLIN CITY UNIVERSITY

INFORMED CONSENT FORM

Project Title: Evaluation of Go-Games

Principal Investigators: Prof. Niall M. Moyna
Mr. Michael Whelan

I. **Introduction to the study:**

The GAA have recently launched a series of mini-conditioned games, called "GO-Games" for children under the age of 12. These games form the core element of the GAA'S long-term player development pathway, and are called First Touch, Quick Touch and Smart Touch for U-8, U-10 and U-12 respectively. The aim of the Go-Games is to maximize participation, and the enjoyment and skill level of each child. To our knowledge no studies have evaluated how effective these games are at accomplishing these aims, and how they compare to standard games. This study will compare enjoyment levels, the number of times that selected skills are performed, the physiological demands, and each child's perception of their ability to play during the Go-Game, Quick Touch, and standard games. Children will be recruited from GAA clubs in the Dublin area. The subjects will participate in two Go Games, one 9 a-side regular game, one regular 15 a-side game and one modified 9 a-side game. Each game will be videotaped and analyzed. Players resting heart rates will be obtained prior to the first game. Following each game, a questionnaire will be completed to assess enjoyment levels and perceived competence. An initial visit will be made to each club to explain the study to parents and club officials.

II. My child is being asked to participate in this research study. The study will

Compare the physiological responses in U-10 players during a Go-Game (Quick Touch) generic and Dublin modified rules, a regular 9 a-side game, a regular 15 a-side game and a modified 9 a-side game.

Compare the number of times that selected skills are performed during all the games.

Compare levels of enjoyment and perceived competence during all the games.

III. <u>This research study will take place at various GAA Venues</u>

IV. <u>This is what will happen during the research study</u>

My child will be asked to fast for 3 hours and refrain from any strenuous physical activity for 24 hours before each football game. Prior to the first game I will complete a brief questionnaire to insure that my son/daughter is in good health.

My child will have his/her resting heart rate measured prior to their first game. My child will sit for 10 minutes with a heart rate monitor around their chest. My child's lowest heart rate will be recorded as resting heart rate.

My child will have his/her heart rate measured during the Go-Games (Quick Touch), a regular 9 a-side game, a regular 15 a-side game and a modified 9 a-side game.

Prior to each game a heart rate monitor will be placed around his/her chest. The monitor will be removed immediately after each game. The heart rate monitor will automatically record his/her heart rate during the game. Each game will be recorded on video in order to assess my child's involvement in the game.

V. <u>There may be benefits from my child's participation in this study. These are:</u>

I will receive a copy of my child's personal results and the overall results when the study is completed. I will also be invited to a presentation that will describe the principle findings of the study. No other benefits have been promised to my child.

VI. <u>My child's confidentiality will be guarded:</u>

Dublin City University will protect all the information about my child and his part in this study. My child's identity or personal information will not be revealed, published or used in future studies. The study findings will be used for research purposes The study findings may be presented at scientific meetings and published in scientific journals.

VII. <u>If I have questions about the research project, I am free to call Prof. Niall Moyna at 01 7008802 at any time.</u>

VIII. <u>Taking part in this study is my decision.</u>

If I do agree to allow my child to take part in the study, he may stop at any point, before or during testing, without penalty. However, once testing has been completed I will not be able to withdraw my child's information from the study.

IX. <u>Signature:</u>

I have read and understand the information in this form. The researchers have answered my questions and concerns, and I have a copy of this consent form. Therefore, I consent to allow my child to take part in this research project entitled "Assessment of Physiological Responses and Activity Patterns in Children During Gaelic Football"

Signed: _____

_____

(Printed name)

Date: _____

Witness: _____

(Signature)

Study 3

DUBLIN CITY UNIVERSITY

ASSENT FORM

Study Title: Evaluation of Go Games

My parents/guardian have talked to me about being part of a research study.

1. I have been told I will wear a heart rate monitor and have my resting heart rate recorded.

2. I have been told I will play in five different football games; a 9-a-side regular game, a 9-side modified game, a Dublin league Go-Game, a 15-a-side game and in a generic Go-Game.

3. I will have my heart rate measured during all games. Before each game I will have a heart rate monitor placed around my chest. The monitor will be removed immediately after each game. The heart rate monitor will automatically check and record my heart rate during each game. Each game I play will be recorded on a video.

4. After each of the games, I will complete a short questionnaire to find out how much I enjoyed the game and what I think about my football ability. It will take about 10 minutes to complete the questionnaire. I will be allowed to ask questions if I do not understand anything.

5. I will not do any exercise that makes me tired the day before the games.

6. I know I can withdraw at any stage from any of the games if I want to, and no one will be upset with me.

7. I know I can ask my parents/guardians, coach or anyone from DCU any questions or concerns at any time during the study.

SIGNED: _____ DATE: _____
(Participant's name)

SIGNED: _____ DATE: _____
(Witness' name)