

**Investigating suitable pitch sizes for young football
players in New Zealand**

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ATTESTATION OF AUTHORSHIP

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

Date

Willy Gerdson

GLOSSARY OF FOOTBALL TERMINOLOGY

The following football specific terminology will allow comprehension of this paper by the non-football reader.

Beehive effect:	Bunching of players in a small portion of the pitch.
Double pass:	(aka one-two) - Player A passes the ball to Player B. Player B then immediately passes the ball back to Player A.
Dribbling:	(aka Carrying) - The basic skill of advancing and controlling the football ball with the feet. A player can dribble the ball with any part of the foot/feet. "Control dribbling" is usually performed with the inside or outside of the foot. "Speed dribbling" (moving with the ball at pace) is typically performed with the top of the foot.
Football pitch:	The enclosed playing area and playing surface for the game of football (soccer).
Free kick:	A free pass or shot that is awarded for a foul or infringement by the opposing team. The ball is placed on the ground and must be stationary before being kicked.
Inside foot:	The side of the foot between the heel and the toe along the inner ankle.
Pass:	A pass is a ball played with the foot (kicked), head, chest or thigh, that is intended to be received by a team-mate.
Push pass:	A pass in which most of the inside of a player's boot comes into contact with the ball.
Small-sided game:	A match played with fewer than 11 players per side.

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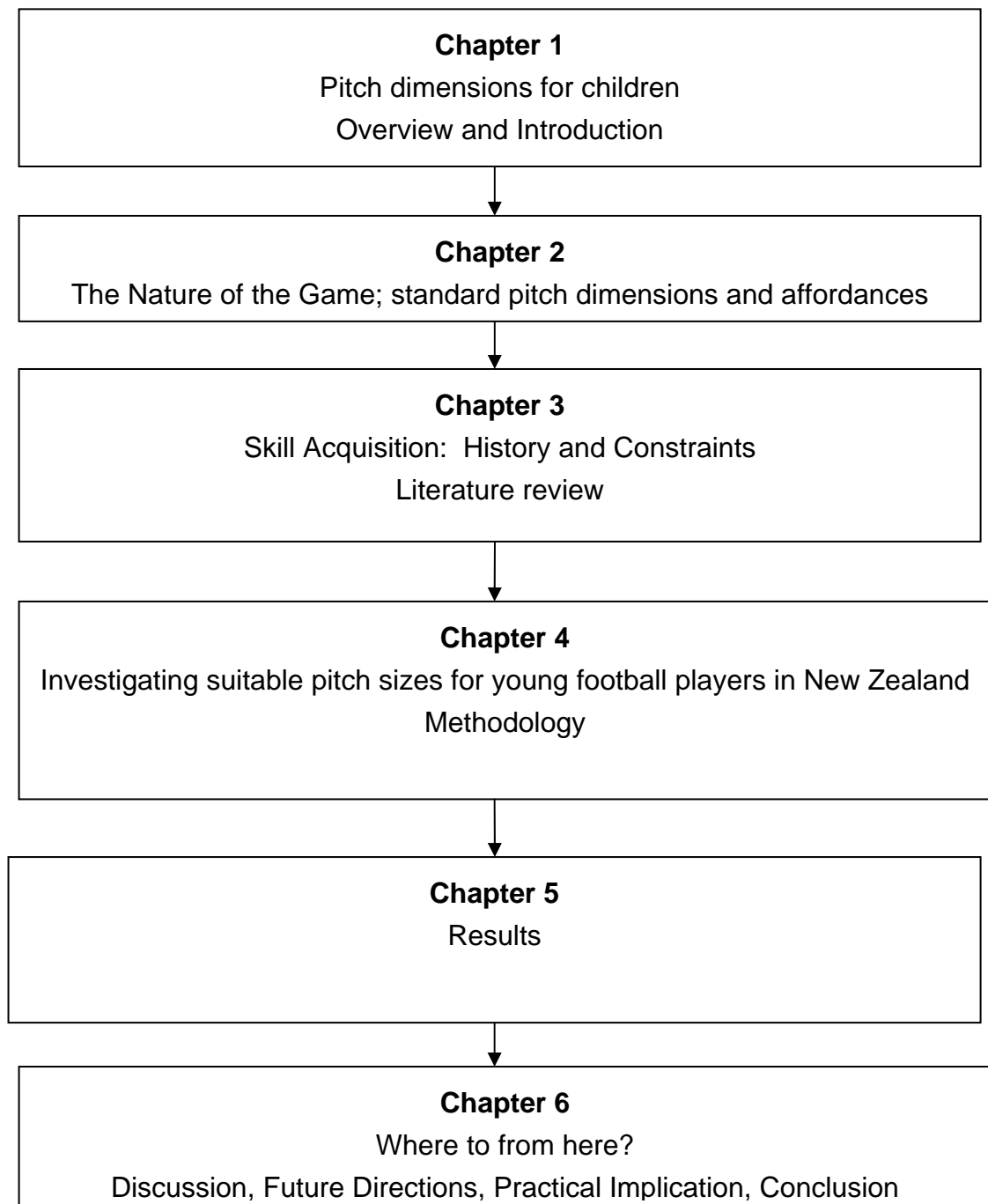
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Finally, my wife Anja, thanks for all your love, patience and support. I could not have done it without you.

Note to Reader

This thesis is presented in the traditional structure as an introduction and literature review. The thesis is made up of 6 chapters, the structure of which is shown in the flow chart below.

Figure 1: Flow chart of the work.



ABSTRACT

Whilst smaller pitches have become the norm in junior football, they may still be too large for certain ages and levels of skill. To date there has been no research into the relationships between size of the pitch and the technical kicking ability (distance and accuracy) of young players (8 - 14 years of age). The purpose of this investigation was to examine variables that influence actual kicking distance and accuracy and also to measure what differences in play behaviour (passing and dribbling) emerge from self-selected changes in pitch size for different age groups (9 and 10 years of age).

Data were collected on 120 (N=120) junior football players: Playing experience (M=2.85 years, SD=2.56), Height (M=1.44 m, SD=1.08), Weight (M=37.8 kg, SD=7.69), Lengths of lower limbs (knee/ankle: M=35.54 cm, SD=4.27; hip/knee: M=35.54 cm, SD=5.25), Step lengths (M=37.66 cm, SD=8.693), Estimated kicking distance (M=31.13 m, SD=16.63). Participants performed a series of three kicks along the ground, using the inside of the foot, and aiming for a target (25 m away). The distance (M=18.04 m; SD=6.56) and accuracy (M=8.32 m; SD=4.38) of each kick were measured.

The children (9 and 10 years of age) were then assigned to teams and asked to construct a small-sided game on two different pitch sizes. The first pitch size used was the recommended regulation size. The second pitch size was self-selected by the players. Any changes to the playing dimensions (e.g., width of the pitch) and playing behaviours (e.g., total number of passes, dribbling) were measured and analysed.

Kicking distance is best predicted by the player's height (20.0%, $P < 0.000$), or a combination of the player's height and estimated kicking distance (30.0%, $P = 0.002$). Kicking accuracy can be attributed to the influence of the player's step lengths (8.1%, $P = 0.016$) and both their step lengths and estimated kicking distance (15.1%, $P = 0.020$). Furthermore, our findings demonstrate that the increase in pitch size (18.5% and 25%) resulted in a greater amount of dribbling (63% and 33%) and passing (12%).

In general, our results support the idea that young children in New Zealand should be playing on a pitch and at a skill level which matches their football abilities. Grouping young players on a pitch according to their physical (e.g.,

height) and technical kicking ability (e.g., distance, accuracy) instead of their chronological age, seems to be the key factor to any other set of proposals. The findings of this thesis have important messages that could enhance the effectiveness of coaching, competitive game-play (pitch sizes) and consequently performance at all junior levels of football in New Zealand.

Further research should manipulate the number of players per team to see if this factor affects competitive game-play in junior football. Additionally, the mean distances maintained between players in the same team (team-mates) during game play needs to be considered (with regard to the 'beehive effect'). Further studies should examine different age groups of equivalent skill level and assess their performance in relation to their technical kicking ability on different pitches.

Keywords: Football, pitch dimension, constraints, children, kicking, passing, and dribbling.

CHAPTER 1

PITCH DIMENSIONS FOR CHILDREN

OVERVIEW AND INTRODUCTION

Overview

Manipulating constraints is an integral aspect of developing emergent learners' movement capabilities (e.g., Renshaw, Chow, Davids, & Hammond, 2007). Research into manipulating constraints is an emerging aspect of the dynamical systems approach to motor development. This approach is concerned with how athletes' movement emerges from the self-organisation of the performer, the nature of the performers' environment and the demands of the task (e.g., Newell, 1986). An excellent example of constraint manipulation is the way in which coaches alter pitches in size to allow learners to develop decision-making skills in invasion sports such as football (e.g., Williams & Hodges, 2005).

In line with current moves (e.g., in Australia) to match pitch dimensions with developmental capacity/limitations, the current study seeks to examine in detail the relationship between player size, perceived / actual playing (kicking) ability and pitch dimensions in football. More specifically, the value in matching pitch dimensions to children's physical size and chronological age is examined. Therefore, the aim of the project is to determine the developmentally appropriate competition pitch size for young children playing football.

Introduction

The modern game of football (soccer) was established in England following the formation of The Football Association (FA), whose 1863 Laws of the Game created the foundations for the way the sport is played today. According to a survey conducted by football's international governing body Federation Internationale de Football Association (FIFA), published in the spring of 2001, over 250 million people regularly play football in more than 200 countries in every part of the world. It is therefore widely claimed to be the most popular sport in the world. The fact that more than one billion people around the world watched the Football World Cup in June 2006 highlights the significant and

important contribution that the sport of football makes on many levels within today's society (FIFA, 2006). Despite the continued dominance of rugby as a winter sport in New Zealand, numbers of participants in football are increasing at all levels (New Zealand Soccer (NZS), 2005). The nature of the game, the simple rules and the minimal equipment requirements have no doubt aided its spread and growth in popularity (FIFA, 2006).

In children's football, administrators and coaches often organise children's games on adult size pitches, with adult size goals and adult size equipment. This is often done with the desire to get children playing the 'real' game as soon as possible. However, the individual and developmental constraints often lead to children having to develop unique solutions to performance demands (Williams & Hodges, 2005). Although football coaches are able to adjust pitch sizes in training sessions to match the emergent constraints of the individuals they are working with (Guerin & Kunkle, 2004), in competition, pitch sizes are set by administrators. The adult sized pitch was defined in 1897; 100–130 yards by 50-100 yards for domestic matches; 110-120 yards by 70-80 yards for international matches (FIFA, 2007). Given the relative increases in height and fitness levels of the players of today, in comparison to the players of the late 1800's, it could be argued that in order for the game to reflect the skills and strategies of the initial law makers, the pitch size (and goals) should be increased to reflect these changes. Indeed, the reduction in the numbers of goals scored over time has led to many observers suggesting the need for bigger pitches or a reduction in the number of players on the pitch.

How the law makers determined the initial pitch dimensions is unknown and in a similar way, whilst recommended pitch sizes are available for children (see Appendix 1), the dimensions of pitches for children's competition have not been designed based on any empirically derived understanding of the constraints of children (Lee, 1993). In line with other sports such as tennis, rugby union, badminton and hockey, administrators from football associations have attempted to 'body scale' pitch dimensions (and ball sizes) to suit the needs of the 'smaller' player, enabling them to play a game that is reflective of the adult game (Lee, 1993). For example, in the USA, the football pitch size for youth has been based on the size of the step and the length of the kick of each age group

relative to adults (Huddleston & Huddleston, 2007; US Youth Soccer, 2007; Lee, 1993). Using the size of the step alone makes little sense for children because it does not adequately reflect their skill level, playing experience or development stage.

In addition, some governing bodies have already introduced laws of play specifically for the junior game (less than 16 years of age) which can apply in competitive matches. Australian football administrators for example have been working on a root-and-branch reform programme for all levels of the game announcing a series of changes in November 2007 (Lynch, 2007). Among the recommendations were philosophical changes to the way junior football is played and coached, with more emphasis on skills development through teams of fewer players rather than having juniors as young as 10 playing competitive games on full-size pitches (Lynch, 2007). Therefore, the football field size should at least be in proportion to the player size, age, technical kicking ability (distance and accuracy), and the number of players on the pitch at a given time. It has been argued that smaller fields are much better suited to the kicking ability (distance and accuracy) of youth players (US Youth Soccer, 2007). However, despite the importance that appears to be attached to kicking ability as a constraint on the design of pitch dimensions, there is no published data available that looks into this relationship in children (8 - 14 years of age) (Lee, 1993).

Passing is one of the most important techniques in the game. It allows players to move and position the ball accurately to other players, or to move up the field (NZS, 2006). Specifically, the decision to pass the ball or run with the ball is most likely to be determined by perceived ability to make a successful pass. Several factors have been suggested that influence the passing decision. These include the dimensions of the pitch, coach encouragement, the number of players on each side, the position of players, the ball size, the rules adopted, and the physical size of the player (e.g., Rampinini, Impellizzeri, Castagna, Abt, Chamari, Sassi, & Marcora, 2007; Impellizzeri, Marcora, Castagna, Reilly, Sassi, Iaia, & Rampinini, 2006). Not only does physical size of the participant influence the dimensions of ideal playing areas but so also do the limitations of physiological development (Lee, 1993). Therefore, young children cannot kick a

ball as far and as accurately as adults can. The quality of these skills demonstrated each competition day is influenced by environmental constraints (e.g., Newell, 1986; Savelsbergh & Van Der Kamp, 2000; Oudejans & Collen, 2003).

Pitch size is an integral variable in constraints-led sports performance and learning. Specifically, pitch size will determine distance between players on the field at the start (and re-start) of game-play, which is often greater than the perceived kicking efficacy of younger players (Huddleston & Huddleston., 2007). Whilst smaller pitches have become the norm in junior football, they may still be too large for certain ages and levels of skill (Lee, 1993) and, as noted above, to date there has been no research into the relationships between size of pitches, age, maturation, and movement capabilities of players.

The present study sets out to investigate the relationship between size of the pitch and the technical kicking ability (distance and accuracy) of young children (8 - 14 years of age). Therefore, the first part of this study was the examination of factors (e.g., height, weight, age, step lengths, estimated kicking distance) that predict kicking distance and accuracy. In addition it was predicted that with a smaller pitch size, the age group 9 - 10 years of age would experience an increase in passing and a decrease in transport (dribbling). It was expected that by determining a developmentally appropriate pitch size, passing distance between players during game-play would be reduced to a more 'efficacious' (suitable) distance. The key word here is efficacious as it underpins the decision to actually make a pass. This decision may in turn be determined by explicit processes such as the instruction to pass into space and the implicit and or explicit estimation of whether such an action will eventuate in a successful outcome. The cost of losing possession of the ball being far greater than the cost of not being seen to pass the ball in most situations. This is to some extent tied to passing ability and inter-player distance. In creating a smaller pitch the inter-player distance will be reduced, arguably increasing the probability of passing. It would be expected that this line of argument will be confirmed by players own estimates of suitable pitch size. It is also argued that there is a critical pitch size for each age group that would determine the presence or

absence of a passing game and the incidence of the “beehive effect”. If the findings provide participants with pitches that are appropriate to their development stage, participating on appropriately sized pitches can encourage greater participation in sport. In addition, local authorities (e.g., Auckland City Council, North Shore City Council) will be able to accommodate more teams playing football if the pitch sizes are found to be too large at present.

CHAPTER 2

THE NATURE OF THE GAME, STANDARD PITCH DIMENSIONS AND AFFORDANCES

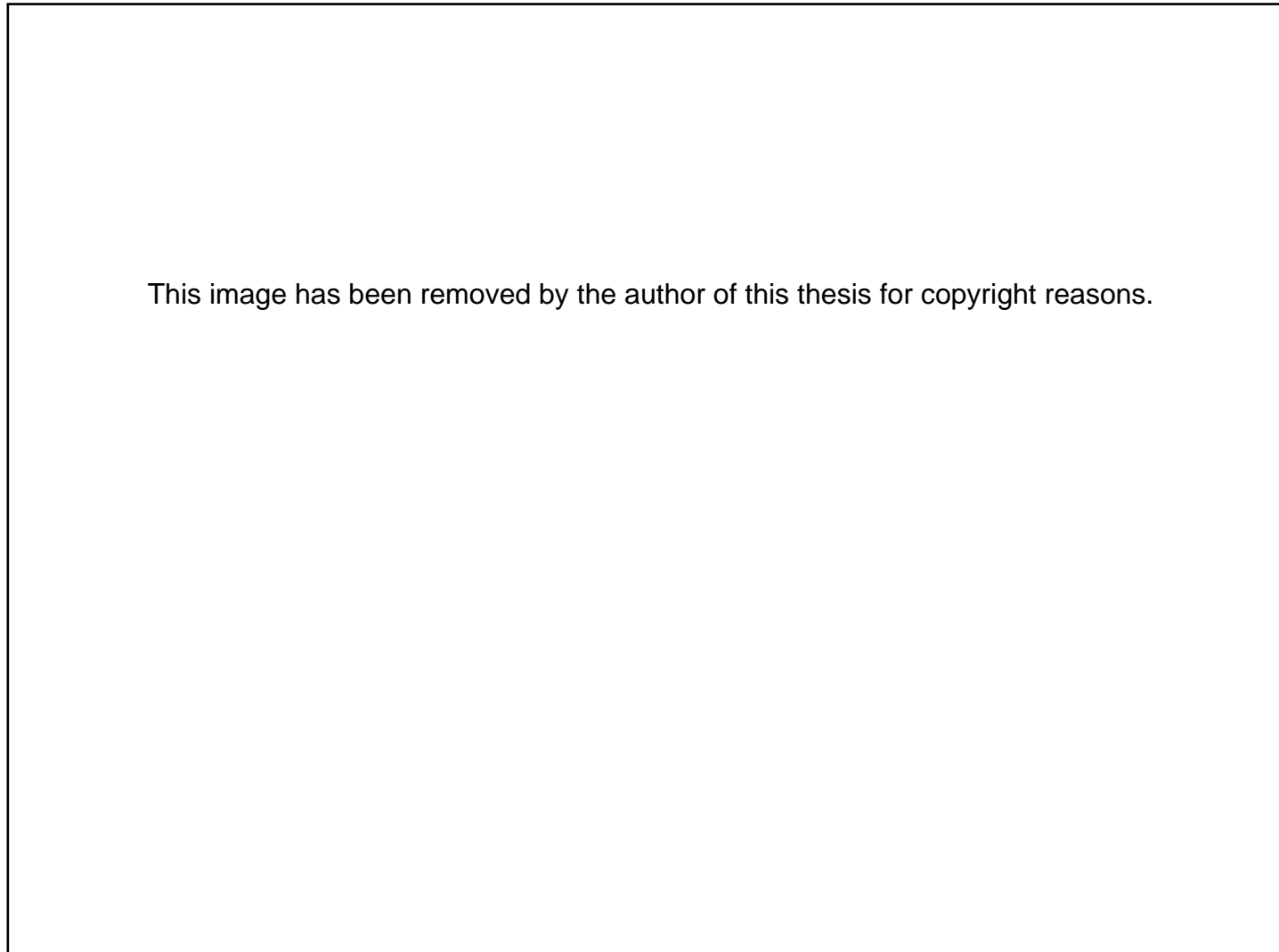
Prior to the analysis of pitch dimensions, it is necessary to first explore the nature of the game and the relevant historical and environmental aspects of football, to provide information that has affected pitch dimensions for youth players to date. Association football, commonly known as football or soccer, is a team sport played in accordance with a set of rules known as the Laws of the Game (FIFA, 2007). Football is a ball game played using a single round ball (the football) on a rectangular grass or artificial turf field, with a goal at each of the short ends. The object of the game is to score by manoeuvring the ball into the opposing goal. Each team consists of a maximum of eleven players (excluding substitutes), one of whom must be the goalkeeper. Competition rules may state a minimum number of players required to constitute a team; this is usually seven. Though there are a variety of positions in which the outfield (non-goalkeeper) players are strategically placed by a coach, these positions are not defined or required by the Laws (FIFA, 2007).

In typical game play, players attempt to create goal scoring opportunities through individual control of the ball, such as by dribbling, passing the ball to a team-mate, and by taking shots at the goal, which is guarded by the opposing goalkeeper. Opposing players may try to regain control of the ball by intercepting a pass or through tackling the opponent in possession of the ball; however, physical contact between opponents is restricted. Football is generally a free-flowing game, with play stopping only when the ball has left the field of play or when play is stopped by the referee.

Field Dimension

The field descriptions that apply to adult matches are described below (Figure 2). It is noteworthy that due to the original formulation of the Laws in England and the early supremacy of the four British football associations, the standard dimensions of a football pitch were originally expressed in imperial units. The Laws now express dimensions with approximate metric equivalents (followed by traditional units in brackets), but use of the imperial units remains common in some countries, especially in the British Isles.

Figure 2: Football Field Dimension.



(FIFA, 2007)

Marking areas

All line markings on the football pitch form part of the area which they define. The centre mark is indicated at the midpoint of the halfway line. A circle with a radius of 9.15m (10 yards) is marked around it (FIFA, 2007).

Goal area: Two lines are drawn at right angles to the goal line, 5.5m (6 yards) from the inside of each goal post. These lines extend into the field of play for a distance of 5.5m (6 yards) and are joined by a line parallel with the goal line.

Penalty Area: Two lines are drawn at right angles to the goal line, 16.5m (18 yards) from the inside of each post. These lines extend into the field of play for a distance of 16.5m (18 yards) and are joined by a line drawn parallel to the goal line. Within the penalty area, a penalty mark is made 11m (12 yards) from the midpoint between the goal posts and equidistant to them. An arc of a circle with a radius of 9.15m (10 yards) from the penalty mark is drawn outside the penalty area.

The Corner Arc: A quarter circle with a radius of 1m (1 yard) from the corner flag post is drawn inside the field of play.

Goals: Goals must be placed on the centre of each goal line. The distance between the posts is 7.32m (8 yards) and the distance from the lower edge of the crossbar to the ground is 2.44m (8 feet).

Affordances

The pitch size in football offers a set of affordances. According to Williams, Davids, and Williams (1999), affordances represent possibilities for action in a sport context.

An affordance refers to a property of the environment which can be detected as information to support an action, and which is related to an individual's ability to use it. For example, an unmarked team-mate affords the opportunity to make a pass for a player with the ball in football; while for a gymnast a three-inch balance beam affords performing back flips (Renshaw, Davids, Shuttleworth, & Chow, in press). The affordance of an environment (e.g., pitch size) is a measure of its capacity to support children's development. Gibson (1986) argues that the affordances of an environment are those elements it offers or provides for the user (e.g., player). Affordances are ecological resources from a functional point of view. They are an objectively specifiable and psychologically meaningful taxonomy of the environment (Zhang, 2006). For example, an environment that contains features that are manipulative, is perceived, used, and transformed in different ways at different stages of the child's development.

In the course of game play, an opponent initially may be perceived as an obstacle, where later he/she may be seen as a source of information for higher-level performance. As children's psychological and physical characteristics change developmentally, the resources the environment offers also change. In sports such as football, the potential movement solutions available to children are strongly determined by the fit between their environment and their current stage of development (e.g., Renshaw et al., in press). For example, a young football player who is required to take a shot at a full size goal on a full size pitch with a full size ball will result in a movement solution that does not reflect that of an adult shooter (e.g., Renshaw et al., in press). This example highlights the dilemma for coaches and administrators about when it is most appropriate to make children's sport representative of the 'adult' version of the sport and when to attempt to scale equipment (e.g., ball size) and performance environments (e.g., pitch size) in relation to the developmental stage of the performer (e.g., Renshaw et al., in press). If coaches/administrators believe that it is important for children to replicate the movements of adults, then it is

important to scale equipment and task environments to the developmental stage of the learner (as opposed to chronological age).

Gibson (1986) underlined that affordances are holistic. What we perceive when we look at objects is their affordance, not their dimensions and properties. Gibson (1986) also made it clear that affordance is not solely the property of the environment; it is jointly determined by the environment and the organism. Affordances are the allowable actions specified by the environment, coupled with the properties of the organism (Williams et al., 1999). An affordance implies complementarity of the perceiver and the environment. Therefore, affordances are both objective (a surface invites an action) and subjective (the specific action depends on critical values of limb lengths of each person) (Davids, Bennett, & Newell, 2006). It cuts across the dichotomy of subjective-objective. Affordances only make sense from a system point of view (Williams et al., 1999; Zhang, 2006).

To exemplify, a football in flight is not perceived in terms of its dimensions or colour. It is perceived in terms of its affordances for action. The lawful structure of the light waves reflected from the ball travelling along a particular flight path specifies the action, which is afforded by a player. The difference in the optic structure stipulates a different affordance for the performer. For example, a football delivered at a certain height affords volleying, whereas a ball at a higher trajectory affords chest control. The individual's frame of reference will specify the affordance uniquely to each player (Williams et al., 1999). The learner is not burdened with the task of developing symbolic memory structures. Instead, the perceptual systems become more 'attuned' to the variant (changing) information in the environment through direct experience in realistic practice and match play. The information picked up becomes more elaborate and precise with task-specific experience (Williams et al., 1999).

The important implication for football is that players cannot be understood without reference to their specific performance environments. In team sports such as football, the environment consists of other individuals such as teammates and opponents, as well as the playing surfaces and inanimate objects that define each specific performance context (such as pitch markings). For an

individual to engage effectively with other individuals, events, surfaces and objects in his/her performance environment, he/she needs to detect the key affordances within that location (Renshaw et al., in press). This highlights the need for coaches to accurately sample the information in the performance environment and to create practice activities that provide athletes with many opportunities to become 'attuned' to the specifying information sources available in that environment (Davids et al., 2006; Renshaw et al., in press). As a result of practice, a process of education of attention leads to learners shifting from picking up non-specifying variables and converge on specifying variables (e.g., Renshaw et al., in press).

Further research is required to expand the understanding of specifying information sources available for young footballers. Consequently, performance environments need to be carefully replicated during practice and training so that athletes can learn to detect affordances for action and to use these sources of information to regulate their movements. Ensuring the design of representative practice tasks requires the coach have an implicit understanding of the interaction between key individual, task and environmental constraints of specific sports performances (e.g., Davids, Chow, & Shuttleworth, 2005).

Newell's (1986) model of interacting constraints predicts that as organismic constraints change and interact with other constraints from the task and environment, the emergent behaviour will alter the perceptual judgement of the individual in each specific setting (e.g., Davids, Button, & Bennett, 2007).

In summary, despite the lack of empirical work, ecological theory predicts that changes due to development can have a direct effect on an individual's perception of affordances (e.g., Davids et al., 2006). Changes in organism constraints (e.g., growth and development) have implications for the acquisition of ball skills for children, in particularly for the equipment design (e.g., ball size) and coaching practices (e.g., reducing or increasing the size of the playing area). Therefore, there is a developmental dimension to the environment (e.g., pitch size), just as there is for the individual child. The utilization of the environment increases with the child's age, alongside their cognitive, affective,

and behavioural capacities; the environment should be designed to facilitate, support, and encourage this developmental growth (e.g., Zhang, 2006).

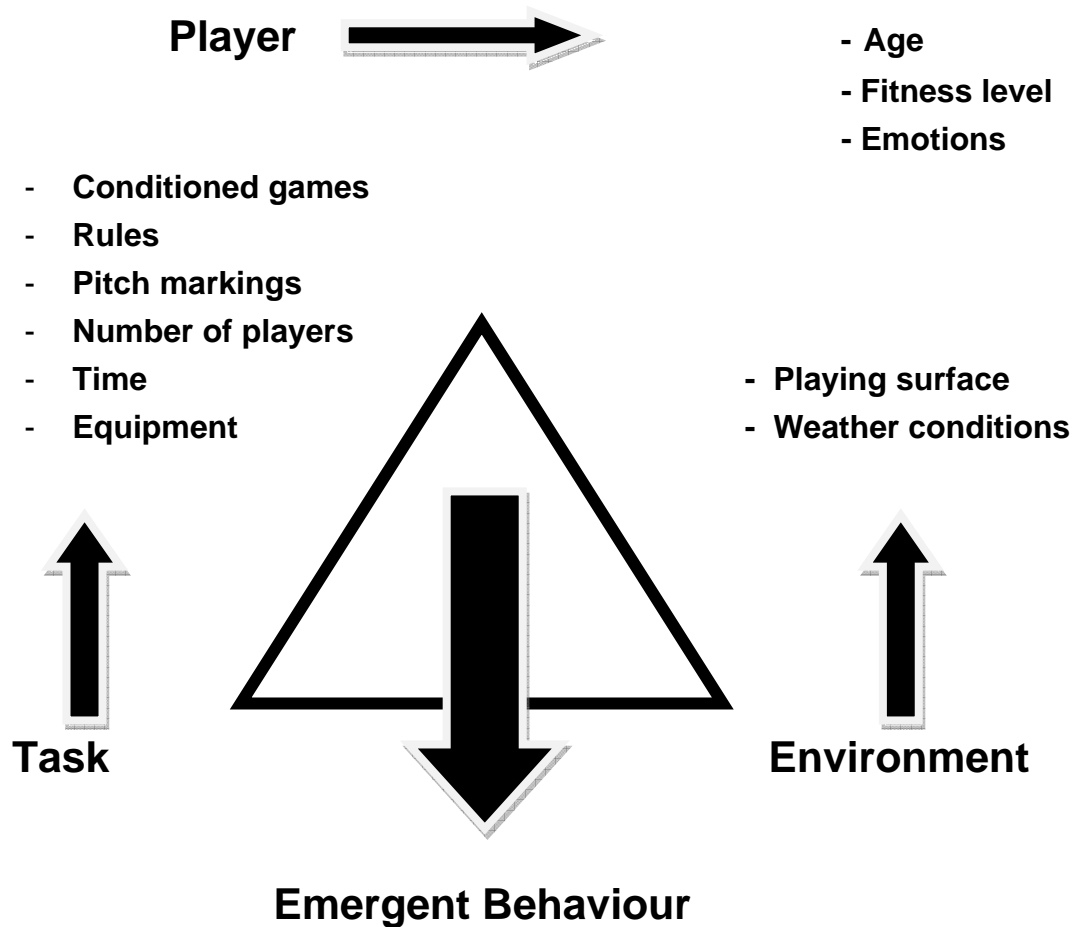
CHAPTER 3

SKILL ACQUISITION: HISTORY AND CONSTRAINTS

Literature Review

To design appropriate environments for performance and learning of movement skills, sports teachers and coaches need a sound theoretical model of the learner and of processes of learning (Renshaw et al., 2007). Although one would expect this to lead to a symbiotic relationship between movement scientists and pedagogists, the usefulness of research in motor learning continues to be questioned by Physical Education specialists and often leads to an unprincipled approach to practice organisation (Renshaw et al., in press). However, the emergence of ecological psychology and in particular the constraints-led perspective as a theoretical framework in motor learning, may be a stimulus to end this unfortunate situation (e.g., Araújo, Davids, Bennett, Button, & Chapman, 2004; Renshaw et al., in press). Via recent applied research in the dynamic interactive settings of sports education (e.g., Chow, Davids, Button, Shuttleworth, Renshaw, & Araújo, 2006), it has become apparent that the acquisition of movement skills occurs as a consequence of the interplay of numerous interacting constraints, which need to be considered in pedagogical practice (Davids, et al., 2005). Newell (1986) classifies these constraints into task, performer, and environmental constraints. The relationship between these constraints and the emergence of movement behaviour is illustrated in Figure 3 (Williams & Hodges, 2005).

Figure 3: A constraints-based model of skill acquisition.



(adopted from Williams & Hodges, 2005)

The individual, environmental and task constraints all interact in order to determine the way that a performer completes a movement related task (e.g., Davids, Savelbergh, Bennett, & Van Der Kamp, 2002). The movement solutions are generated via a process of self-organisation (process of attraction and repulsion in an open system) as performers attempt to satisfy the unique combination of these constraints on them (e.g., Davids et al., 2005). Thus, coaches need a developed understanding of the constraints that shape behaviour when they are working with groups of individuals to develop their performance. Unfortunately, at this present time, there is a lack of empirical work that can guide practice design in specific sports such as football.

Individual constraints include factors such as body size (height, weight, and limb

lengths), fitness (e.g., strength, speed, aerobic capacity, and flexibility), mental skills (e.g., concentration, confidence, emotional control or motivation), perceptual and decision-making skills (e.g., recognising patterns of play, anticipating by reading the movements of opponents) and personality factors (e.g., is a risk-taker, or likes to play safe).

Performer constraints refer to the unique structural and functional characteristics of learners and include factors related to their physical, physiological, cognitive, and emotional make up (Davids, et al., 2006). A learner's morphology, fitness level, technical abilities, and psychological factors, such as anxiety and motivation, may shape the way individuals approach a movement task. These person-related factors provide affordances (possibilities) for action and play a significant role in determining the performance style of individuals (Chow et al., 2006). For example, taller football players are more likely to score goals with headers from crosses, than smaller players who may opt for set shots (e.g., volley) from different distances.

These different constraints on individual learners illustrate the distinct strategies that games players may use to solve movement problems in team sports (Davids et al., 2006). The solutions, which emerge from the activities of different learners, have important implications for how pedagogists structure learning tasks for acquiring movement skills as well as game play. These unique performer characteristics can be viewed as resources for each individual that channel the way in which each learner solves particular task problems or characteristics that can lead to individual-specific adaptations (Renshaw et al., in press). Personal constraints should therefore not necessarily be construed in a negative light by pedagogists, but as an important point in adaptive physical education (Renshaw et al., 2007). It is clear that movement solutions will vary as each individual strives to satisfy the unique constraints on him/her. Variability in movement patterning can play a functional role as each individual seeks to achieve a task goal in his/her own way (Davids, et al., 2006). For example, a football-dribbling task might be conducted within an enclosed area in an attempt to improve close ball control. Such practices also encourage the player to explore alternative movement solutions, and hence optimize techniques in

competition (Davids et al., 2002).

Environmental constraints refer to physical factors such as the surroundings of learners including gravity, altitude and the information available in learning contexts, such as amount of light or level of noise in a gymnasium or sports field (Haywood & Getchell, 2001). Other important physical environmental constraints include the parks, backyards, empty spaces, and alleyways, which provide the backdrop for early sport experiences of many active children (Davids et al., 2007). The importance of these environments should not be under-estimated in the development of expertise in sport as they provide a non-threatening environment where children can learn to play sports without the pressure of adult interference (Davids, et al., 2002). For instance, when teaching young players to kick a ball at each other, accuracy can be facilitated by constraining the environment. Cones can be used to create 'a goal' 2 metres apart. Asking children to pass the ball between them forces them to become more accurate. By gradually reducing the distance between the cones, the constraints become similar to those in a match situation (Savelsbergh, Kamp, Oudejans, & Scott, 2004).

In general, many coaches already use different types of environmental facilitators (e.g., cones, other players). However, these facilitators should always simulate the circumstances in the games situation; otherwise, the relevant information-movement coupling will not be established (Savelsbergh et al., 2004). Additionally, high levels of variability in task demands should be encouraged enabling individuals to become more adaptable performers because they can learn to make decisions in representative practice (Renshaw et al., in press).

A second important category of environmental constraints includes social factors like peer groups, and social and cultural expectations. Such factors are of particular relevance for young learners whereby motor learning is often strongly influenced by group expectations, trends and fashions, and the presence of critical group members such as the teacher or classmates (Magill, 2004). Availability of parental support, access to high quality teaching, and

adequate facilities are powerful environmental constraints on movement skill acquisition recognized by physical educators (Chow et al., 2006; Davids et al., 2006). These constraints could include cultural norms (e.g., Germany produces great football players), as well as societal expectation (e.g., the expectation that players will be rugby players in New Zealand, football players in England and basketball players in New York). Furthermore, the development of appropriate attitudes and behaviours is an important aspect of the development process. It involves the establishment of an appropriate ethos or culture in order to build a self-reinforcing coherent environment (Martindale, Collins, & Daubney, 2005). The importance that a society places on a particular sport (e.g., football, rugby) can have a significant influence on any success achieved (including playing style). For example, New Zealand does not have a long and successful history in football and therefore does not have an appropriate environment or 'status'. Consequences of such a culture include a high likelihood that many youngsters with football potential are more likely to pursue other sports (e.g., Bloom, 1985; Martindale et al., 2005).

Task constraints are perhaps the most important constraints for physical educators because of their significance in learning (Renshaw et al., 2007). They include the goal of the specific task, rules and laws of the activity (game) and the implements or equipment used during the learning experience. The proficiency with which physical educators can manipulate task constraints like modifying equipment available to learners, or the size of playing areas, setting relevant task goals in games, or enforcing specific rules for performance can shape the emergence of learner's behaviours in physical education. Task constraints play a powerful role in influencing learners' intentions and are open to manipulation within an instructional setting (Renshaw et al., 2007). To exemplify, when using the popular Teaching Games for Understanding (TGfU) approach to teach an invasion game such as football, teachers often change the dimensions of the pitch as practice environments to encourage emergence of particular movement solutions (e.g., Davids et al., 2007; Renshaw et al., in press). Coaches can create narrower and shorter pitches to increase the proximity of opponents, forcing them to adopt strategies to cope with these more severe spatial and temporal demands. The perceived information from the

task constraints (smaller pitches), together with the intention of the performer, will accentuate the overall variations in decision-making (e.g., to pass the ball on the first touch or to shield the ball away from opponents). This manipulation of task constraints would lead to the performers having to make quicker decisions and to develop more precise control and passing skills. In children's football, a key factor concerns the role of the coach in structuring task constraints and organising practice environments. Perhaps the most significant task constraints include the structure and organisation of activities that coaches use to simulate strategic sub-phases of the game, such as attacking or defending in football (e.g., Araújo et al., 2004).

Another important task constraint is team size. Just like pitch dimensions, many sports set up competitions that mimic the adult versions of their sports. For example, when researchers at Manchester United Football Club changed the games of their Academy players from 8 versus 8 to 4 versus 4, they were amazed to find that the number of shots, passes, and one-on-one challenges increased far more than the double they would have expected. They pointed out that the use of small-sided games meant that the young players were required to perform a greater number of skills resulting in rapid technical and tactical development of the players (e.g., SPARC, 2007). In addition, players are involved in the game more often and therefore must concentrate continually, without taking breaks. Those who make mistakes must remain involved in play immediately. Given they will have more time on the ball and typically more success in tactical decision making, players will enjoy the game more.

One final task constraint that needs to be mentioned is instructions. Instructions given by coaches about how to complete a task play a major part in determining how an athlete will attempt to achieve the set goal. Coaches need to understand that the instructions they give could determine the movements that the athletes produce to achieve the set goals (Renshaw et al., 2007). Instructions can act as a limiter to performance and discourage athletes from exploring different movement solutions. During performance, the nature of the task provides the overarching constraint that shapes performance. In practice, coaches can manipulate the task constraints in order to direct the athletes'

search for solutions. For example, small-sided games are more effective for learning skill than drills (e.g., Williams & Hodges, 2005). Providing feedback on every practice attempt limits learning potential as it prevents the learner from searching for solutions.

Coaches should avoid attempting to 'control the uncontrollable' by designing drills that limit decision making and actions of performers. In fact, training programmes based on a sound understanding of constraints should be developed (e.g., Renshaw et al., in press). Additionally, coaches should encourage learners to increase their own ability to use intrinsic feedback (feedback about their own movements). One way of doing this would be to categorise athletes in stages, according to Newell's (1985) model of motor learning (e.g. co-ordination, control and skill). An individual at the co-ordination level would be attempting to assemble a suitable co-ordination pattern to achieve a task goal. This performer would often solve the problem by freezing the mechanical degrees of freedom of the body (Bernstein, 1967, as cited in Anderson & Sidaway, 1994; Davids et al., 2007). At the control level, the performer would have successfully developed a co-ordinated pattern and is now attempting to develop a tighter fit between the assembled co-ordinated structure and the environment (Davids, et al., 2007). This is often typified by a greater release of the degrees of freedom enabling more efficient movement patterns. Unfortunately, there is some disagreement about the universality of the freezing and releasing of the degrees of freedom during the learning process (Van Emmerik, Hamill, & McDermott, 2005).

However, the key message is that coaches need to realise that one size does not fit all in terms of practice activities and understanding intrinsic dynamics of each individual provides the basis for programmes that truly individualise the coaching process. Furthermore, coaches should manipulate the individual, environmental and task constraints to help shape the learners performances through guided discovery and self-exploration (Chow et al., 2006). The advantages of less prescriptive approaches such as guided discovery have been advocated recently by many scientists and practitioners (e.g., Araújo, et al., 2004).

The emphasis when learning by guided discovery is on players taking responsibility for their own development, finding unique solutions to movement problems through exploration and discovery (Williams & Hodges, 2005). These more “hands-off” approaches may be more effective in developing “smart” learners who are able to apply their skills in a variety of performance situations (i.e. what has been termed “adaptive” rather than “routine” expertise). These perspectives view the performer as a dynamic and complex system with the observed pattern of behaviour being a by-product of the unique constraints imposed on the learner. According to this viewpoint, movement coordination is achieved as a result of learners adapting to the constraints imposed on them during practice (Renshaw, et al., in press). For example, football players learn to adapt their coordinative structure for kicking a ball so that they can use it under changing conditions. These conditions may include, for example, side foot passes; pitches that vary in dimensions; changing weather conditions; and motor system fatigue (Davids, et al., 2007). Anderson and Sidaway’s (1994) detailed analysis of football players confirms these differences. They found that novice kickers did not show the same coordination patterns associated with expert kickers.

French and McPherson (2004) found that expert kickers produced movement patterns of greater consistency and adaptability when compared to novices. In addition, expert kickers are known to be faster and more accurate in recognizing movement patterns (French & McPherson, 2004). Williams (2000) confirmed that skilled performers are faster in recognizing and recalling patterns of play, are better at anticipating their opponents’ action, have more effective visual search strategies, and are more accurate in their expectation of what is likely to happen given a particular set of circumstances.

The consensus seems to be that expert performers develop knowledge and skill that enables them to deal effectively with a variety of related performance scenarios (e.g., Williams, Ward, Smeeton, & Allen, 2003). Although the ability to recall and recognize structured playing sequences is regarded as the strongest predictor of anticipation skill in football, no attempt has been made to determine the minimal essential information underlying the pattern recognition process

(Williams et al., 1999).

If the philosophy endorsed by “constraints-led” approaches to instruction is to be embraced, the challenge for coaches is to determine how best to create practice opportunities for players to learn on their own (Williams & Hodges, 2005). Therefore, coaches are encouraged to manipulate these constraints such that the desired behaviour emerges through guided discovery and self-exploration (e.g., players taking responsibility for their own development, finding unique solutions to movement problems through exploration and discovery), rather than via prescriptive instruction (e.g., authoritarian approach with frequent use of demonstration and verbal instructions) (e.g., Williams & Hodges, 2005). Approaches such as Teaching Games for Understanding (Bunker & Thorpe, 1982) can be used by coaches to provide discovery learning opportunities that minimise potential disruption to performance by unnatural explicit instruction. Some examples of how constraints may be manipulated to encourage effective learning in football are highlighted in table 1.

Table 1: *Examples of how certain behaviours can be encouraged during practice by manipulating various constraints*

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(William & Hodges, 2005)

Although football coaches are able to adjust pitch sizes in training sessions to match the emergent constraints of the individuals they are working with, in competition, pitch sizes are set by administrators. The adult sized pitch has remained unchanged since the Laws of Association Football were written in England in 1897. The original (1863) association rules said only that the field could not be bigger than 100 yards by 200 yards; in 1875, they added that it could not be smaller than 50 yards by 100 yards.

The present dimensions were laid down in 1897; 100–130 yards by 50-100 yards for domestic matches; 110- 120 yards by 70-80 yards for international matches (FIFA, 2007). Therefore, the maximum and minimum dimensions for both the width and length of the pitch are 50 to 60 yards wide, 100 to 130 yards long. Given the relative increases in height and fitness levels of the players today in comparison to the players of the late 1800's, it could be argued that in order for the game to reflect the strategies of the initial law makers, the pitch size and/or the numbers of player should be changed.

Indeed, Williams (2000) found that skilled football players used different search strategies when viewing the whole field (i.e. 11 versus 11 situations) compared with micro-states of the game (i.e. 1 versus 1, 3 versus 3 situations). Visual search behaviour also differs between defensive and offensive plays (Williams, 2000). In addition, Lee (1993) and Singleton (2006) suggested that players below the age of 12 are not fully able to process information the same way as adults. That is, they are not physically able to process the possible choices of seeing 21 other players on the field and then deducing the best course of action. In fact, it is more than likely that players of this age are not thinking about more than of 3-4 players other than themselves at any one time. Therefore, providing them with extra options to process does not mean they will make better tactical decisions, but rather suggests that the overload of choices will confuse the players and reduce their success rate. This will then reduce their confidence and their overall enjoyment. It is also more likely that players will begin to play only the “safest choices” as opposed to the “most dangerous” choices. This will result in a decrease in attacking creativity and play.

Consequently, any attempt to identify the best age-matched pitch size for children must take into account these factors, together with the influence of growth and maturation across the development cycle (e.g., Williams & Reilly, 2000). Varying field dimensions also include different physiological responses. In some sports, there are obvious physical or physiological variables that are important for successful involvement, such as height in basketball players, long levers in rowers and aerobic capacity in endurance athletes (Morris, 2000).

Even objectively measurable variables, like height, can only be predicted within a range, from adolescence to adulthood. However, there is research evidence to suggest that a player's anthropometric characteristics (e.g., body mass, body composition, bone diameter, limb girth) are related to performance, in important and sometimes complex ways (Owen, 2005).

Physiological measures have also been used in an attempt to identify key predictors of performance (e.g., Williams & Reilly, 2000). Contrasting findings would suggest that the role of anthropometry should be regarded on a sport by sport if not a skill-by-skill basis.

Helsen, Hodges, Van Winkel, and Starkes (2000) suspect that early maturation or physical precocity, is an important characteristic that forms the basis of talent selection. Indeed, a substantial amount of research has demonstrated that elite youth football players are more physically mature than their less developed counterparts are, and that coaches tend to favour players advanced in morphological growth during their selection process (Williams & Reilly, 2000; Owen, 2005). A major problem of selection based on physical precocity is that many of the physical qualities that distinguish elite and sub-elite players may not be apparent until late adolescence, confounding the early selection of performers (Williams & Reilly, 2000). The implication is that the prediction of future elite players from anthropometric measurements may be unrealistic in younger age groups because performance could be affected by the player's rate of physical growth and maturation. It is important that the talent development process is not overly biased towards the early maturing child (Williams & Hodges, 2005). The argument here would appear to support the view that mixing tall kids with small kids is probably worse for play and player

development than mixing slightly older and younger children.

From a practical standpoint, it seems more likely that the development of expertise is dependent on a complex recipe, where innate hereditary factors are blended with the correct environmental factors, such as the influence of parents and coaches, as well as an individual's commitment and motivation to practice (e.g., Williams & Hodges, 2005).

Furthermore, it is acknowledged that appropriate support and training is essential if talented individuals are to fulfil their potential (Abbott & Collins, 2004). Although physiological measures such as maximal oxygen uptake have been successful in distinguishing between experts and intermediate young players, they may not be sensitive enough to distinguish players already selected and exposed to systematized training for national teams (Morris, 2000; Williams & Reilly, 2000).

In addition, the poor predictive validity of junior performance standards for later success, and therefore the need to move away from such a focus, is highlighted by statistics from Bloom's (1985) work. Bloom found that less than 10% of successful elite adult performers were thought to have been at a sufficient performance level at the age of 11 or 12 that would indicate such high long-term achievement. As a further implication, it is worth considering that if 90% of eventual world top 25 athletes do not necessarily stand out as future champions at a young age, what chance is there of identifying the future "journeyman pro" and distinguishing them from other enthusiastic young sportspeople, solely through early performance standards? Size-appropriate game play goes some way to addressing this issue, but to date the approach has not been explored fully.

The findings highlight that young players should be selected based on skill and ability rather than on anthropometric measurements and chronological age. Objective performance measures have failed to differentiate performance in football. For example, objective physiological measurements are thought to only be useful alongside subjective judgements of playing skill for talent development, but in actual fact, such measures do not appear to be sensitive

performance indicators (see, for example, Williams & Reilly, 2000; Williams & Hodges, 2005; Morris, 2000).

Although the anthropometric and physiological characteristics of successful football players have been well psychological and cognitive factors, which may be of equal, if not greater importance in differentiating between more and less skilful players, have not yet been examined. This may be due to the difficulty of developing objective and ecologically valid tests of psychological determinants in football. Similarly, there is considerable evidence of the importance of perceptual cognitive attributes in successful players (Hoare & Warr, 2000; Holt, 2002), but no undertaking to use these as part of the process. Clearly, this highlights that assessing children's ability involves a high level of subjective assessment and that pitch dimensions for junior football players should not be overly biased towards the early maturing child.

How the law makers determined initial pitch dimensions is unknown and in a similar way, whilst recommended pitch sizes are available for children (see Appendix 1) the dimensions of pitches for children's competition have not been designed based on any empirically derived understanding of the constraints of children (Lee, 1993). In line with other sports, such as tennis, rugby union, badminton and hockey, administrators from football associations have attempted to 'body scale' pitch dimensions (and ball sizes) to suit the needs of the 'smaller' child player, enabling them to play a game that is reflective of the adult game (Lee, 1993).

In the USA, the pitch size for youth soccer (football) has been based on the size of the step and the length of the kick of each age group relative to adults (Huddleston & Huddleston, 2007; US Youth Soccer, 2007; Lee, 1993). For example, if a 12-year olds step is about 80% of that of an adult, then the field size should be 80% of the minimum adult size, or about 50-yards by 80-yards. Suggested dimensions for teams might be as in table 2:

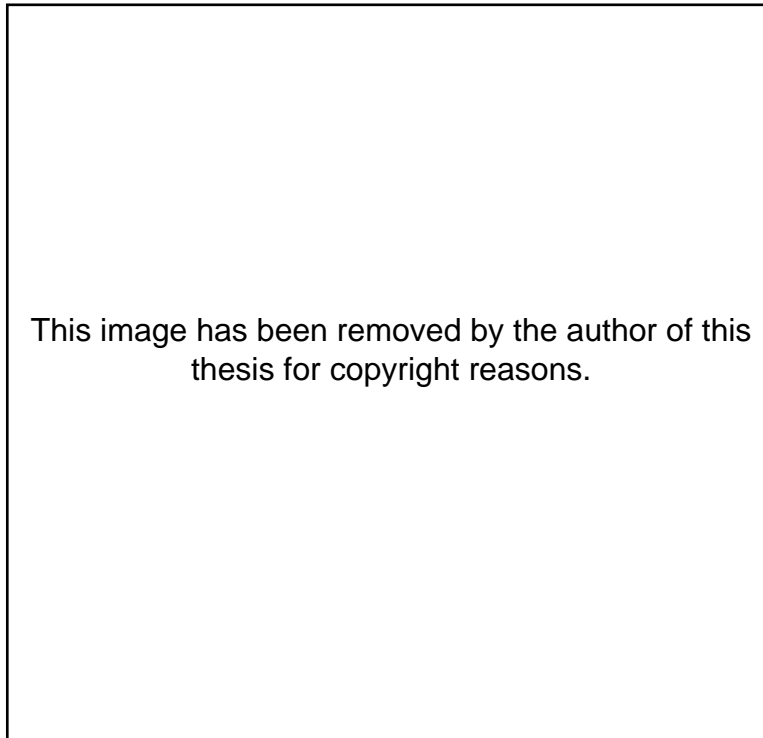
Table 2: *Football Field Size in USA*



(US Youth Soccer, 2007)

In New Zealand, the pitch sizes for youth players are based on the standard dimensions relative to adults. For example, a 9 or 10 year old child plays on a pitch half the size of that of an adult (United Soccer 1, 2005, p. 6). The current pitch dimensions for youth players in New Zealand are shown in table 3. These field sizes are both approximate and recommended maximums (United Soccer 1, 2005). On detailed inspection of documentation, it becomes clear that whilst the need to adjust is recognised, the basis from which these adjustments are calculated is to some extent arbitrary. It was unclear what specifically would be achieved by these changes and how that reasoning actually informed the proportions used in estimating change.

Table 3: *Football Field Size in New Zealand*



(United Soccer 1, 2005)

In addition, research in the United States (Singleton, 2006) found that in an average 60-minute game, each player (12 years of age) in an 8 versus 8 game averaged 3:45 minutes on the ball in comparison to a 11 versus 11 game, where each player averaged 2:44 minutes on the ball. This translates to 38% more time on the ball. When we take into account that the ball typically stays in bounds more often in a small-sided game, the increased exposure to the ball truly pays technical and tactical dividends, as all players are exposed to solvable situations more often. Therefore, they can develop skill and confidence in basic tactical situations. For example, if an 11-year-old is only able to accurately pass a ball 20 yards and cannot physically cross a ball 50 yards, a pass attempting to switch play typically ends up in the middle of the other team's defence, without technical dividends to the players (Singleton, 2006). According to Singleton (2006), asking young players, whose legs are 60% the length and strength of full adults, to cover the same space is inappropriate. German research indicates that requiring players of a young age (U12 and below) to play on full size pitches will mean that they will end up covering more than 4 times the ground that a Bundesliga (Germany's top professional league) player covers in 25 minutes of playing time despite being smaller and having

less developed physiological systems. This is solely due to the larger pitch and does not help players prepare for premier adult play, but rather fatigues them physically and mentally. Perceived and absolute kicking ability in this regard are likely to have considerable influence on the style (e.g., long ball game) of play and consequently the enjoyment of age-group play. If coaches are looking to improve decision making and execution, placing players on a large field works directly counter to their goals (Singleton, 2006).

However, despite the importance that appears to be attached to kicking ability, as an important constraint on the design of pitch dimensions, there is no published data that looks into this relationship with children. Lee (1993) suggests that the football field size should be proportionate to the player's size and age. Smaller fields are much better suited to the kicking ability (distance and accuracy) of youth players (US Youth Soccer, 2007). Youth football games are designed to meet the needs of children. These games are the preferred method of training by coaches and are the most appropriate way of acquiring skills and developing young players. In recent years, administrators of many sports (e.g., tennis) have attempted to develop a competitive structure, which maximizes enjoyment for the children participating (Lee, 1993). For example, the introduction of short tennis (reduced court size, lower net) has allowed many more children to enjoy the game in ways which were not possible on adult sized courts (Lee, 1993).

Bonaccorso (2001) and Verheijen (1998) argued that each learning process in football is connected to both the development of motor skills and the development of social capacities. This means that the performance in football is always an expression of the integrated development of all the various components. Consequently, actual game play matters and pitch dimensions should reflect this.

Summary of literature review

From the various advantages identified in the literature, it is clear that an appropriate size of football pitch will lead to more contact on the ball for children and a greater likelihood of developing motor skills (e.g., movement patterns). To play on a full sized pitch changes the nature of the game for children, because it

does not reflect their skill level, playing experience, and development stage. The relationship between the size of the pitch and the ability of the player to kick a ball accurately over a distance may change dramatically during childhood and again change the nature of the experience of the sport. Adapting the field dimensions allows children to approximate more closely the movement patterns of adult players and hence the techniques of the game, which can be taught and then more readily transferred in to the adult game later. Children's football training should therefore match the game situation as closely as possible (e.g., Savelsbergh et al., 2004).

Whilst smaller pitches have become the norm in junior football, they may still be too large for certain ages and levels of skill (e.g., Lee, 1993) and to date there has been no research into the relationships between size of pitches, age, maturation, and movement capabilities of players. Therefore, the purpose of this research was to determine an ideal competition pitch size for young children playing football. More specifically, the value in matching pitch dimensions to children's technical kicking ability and chronological age was investigated.

Statement of the problem investigated

In order to address the research topic, particular problems of pitch size need to be understood. Specifically, the decision to pass the ball or run/dribble with the ball is most likely determined by the perceived ability to make a successful pass.

Commonly, players are encouraged to spread out on the pitch in order to facilitate a desirable passing game. At the start of a phase of play, players are usually distributed across the field at approximately even distances. Players are encouraged to distribute themselves "in space". If the pitch is too large, the distance between players interferes with a critical pass or run/dribble decision. Typically, when the nearest friendly player (team-mate) is too far away, this will cause a transport phase (run/dribble with the ball) either towards the opposing goal or towards the nearest friendly player (team-mate). As a consequence of the decision to dribble rather than pass, all other players on the pitch close in on the player in possession of the ball. This is commonly referred to as the "beehive effect". The argument is that if players are too far apart they will not pass the ball and the number of attempts at transporting the ball will increase.

This will result in a corresponding bunching of players in a small portion of the pitch, where everyone chases the ball around the field, or, with half of the players standing at one end of the field hoping that someone can kick the ball over halfway. Skilful game-play and enjoyment will therefore suffer. It is hoped that by determining a developmentally appropriate pitch size, passing distance between players (team-mates) will be reduced to a more efficacious distance. This in turn will facilitate greater passing manoeuvres and ultimately more player activity by all players. A 'passing game' is understood by coaches to be more skilful, enjoyable and more active than a game based around dribbling the ball from player to player. Furthermore, it may encourage additional running off the ball.

The first step (Part 1) in this research was to examine the variables that specifically influence actual kicking distance and accuracy. The second step (Part 2) was to measure what differences in play behaviour (passing and dribbling) emerge from self-selected changes in pitch size.

Research question:

What is the best age-matched pitch size for children (8 - 14 years of age) playing football in New Zealand?

In order to answer this question, the researcher needed to address the following:

1. What best predicts kicking distance and kicking accuracy?
2. How do players own estimates of preferred pitch size change with age and/or other variables?

Aim:

To provide guidelines for football pitch sizes, which are developmentally appropriate to allow children (in particular the age group 9 - 10 years of age) to be sufficiently involved in the game.

Significance of the study for the community

By determining ideal pitch sizes there will be several potential benefits to the participants and the wider community. If the findings determine exemplary dimensions of pitch size then the participants will play games in future on pitches that are developmentally appropriate. Participating on appropriately

sized pitches can encourage greater participation in sport. Participation levels of activity through sport are a key focus for developing not only healthier New Zealanders, but also excellent performers. Local Territorial Authorities (e.g., Auckland City Council, North Shore City Council) will be able to accommodate more teams playing football, if the pitch sizes are found to be too large at present and hence be able to provide more opportunities (through the provision of more pitches per hectare) for children to play not only football but other sports (if the current numbers of football players remains at the present levels) by reducing the hectares per game and maximising efficient use of open spaces.

Hypotheses:

Part 1:

Null hypothesis (Ho): There will be no relationship between dependent variables (date of birth; playing experience; height; weight; lengths of lower limbs; step lengths; estimated kicking distance) and kicking distance or kicking accuracy (independent variables).

Alternative hypotheses:

H1: The increase in age, step lengths, lengths of lower limbs, height, weight, and estimated kicking distance will predict an increase in kicking distance

H2: The increase in years of playing experience will predict changes in kicking accuracy

Part 2:

Null hypothesis (Ho): With a change in pitch size, there will be no change in passing and dribbling behaviour (number of passes made or distances dribbled)

Alternative hypotheses:

H1: With the change in pitch size, the number of passes made will increase and the distances dribbled will decrease.

H2: With the change in pitch size, the number of passes made will decrease and the distances dribbled will increase.

CHAPTER 4

INVESTIGATING SUITABLE PITCH SIZES FOR YOUNG FOOTBALL PLAYERS IN NEW ZEALAND

METHODOLOGY

Design

The design of this study falls into two distinct parts: Part 1) Examination of factors that predict kicking distance and accuracy; Part 2) Measuring what differences in play behaviour (if any) emerge from self-selected (by players) changes in pitch size for different age groups. In this way, Part 1 is descriptive to be examined using methods of association, Part 2 is quasi experimental and will be examined via methods of difference.

Part 1) Dependent variables:

Date of birth; playing experience; height; weight; lengths of lower limbs; step lengths; estimated kicking distance

Independent variables:

Kicking distance and kicking accuracy

Part 2) Dependent variables:

Passing and dribbling (number of passes and dribbling)

Independent variables:

Player age and pitch size

Study Limitations

The following are the limitations of the research project presented in this thesis:

1. Videoing took place at the competition venue during a practice session. As such, although players were asked to play as they would in a game situation, the specific constraints of competitive match-play were missing.
2. Several subjects did not complete the whole testing procedure.
3. Chronological age could not be included in the data analysis due to measurement error (data only in years).
4. The data was not sufficient to test fully the 'beehive effect' in terms of mean inter-player distance (not enough cameras).

Participants

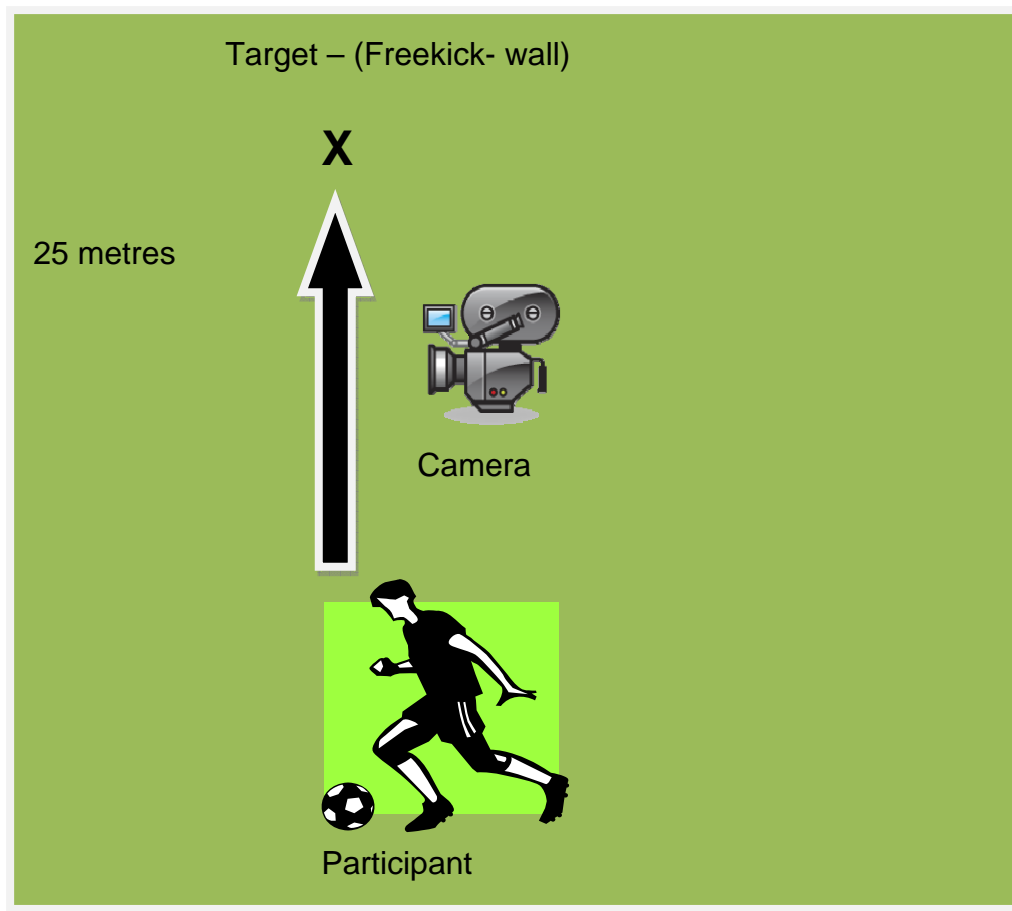
A cohort of 120 junior football players (n=120) from the North Harbour area of Auckland were recruited for this study. The children were currently playing football at a football and/or school club in Metropolitan Auckland. The youngest player was 8 years of age; the oldest player was 14 years of age. The involved clubs selected (via their convenors/age group administrator) players from each of the following grades, providing 120 children in total: 16 players at Grade 9 (8 and 9 years of age); 28 players at Grade 10 (9 and 10 years of age); 37 players at Grade 11 (10 and 11 years of age); 21 players at Grade 12 (11 and 12 years of age); and 17 players at Grade 13/14 (12, 13 and 14 years of age).

This thesis research gained ethics approval (Appendix 2) from the Auckland University of Technology Ethics Committee – 12. July 2007 (AUTEC Reference: 07/41).

As the children were under the age of 16 years (age of consent for research), the parents or caregivers were required to sign the Consent to Participate form (Appendix 3 and 4). A letter (Appendix 5) was sent to football clubs in Auckland, which have large numbers of child members. The letter requested the recruitment of boys and girls who play football in the 9 to 14 age grades (8 - 14 years of age). The principal researchers also verbally requested assistance from these clubs via the club secretaries. Information forms (Appendix 6) were given to the parents/caregivers of the selected children. The children (8 - 14 years of age) were also able to give verbal consent and had this opportunity again on the day. Participation was voluntary. Those choosing not to participate in the data collection (e.g., subject 47) were still permitted to take part in game-play. All players consenting to participate in the research projects had to be free from any limiting injuries at the time of testing.

Apparatus

Figure 4: Diagram of the set-up metre.



Coaching cones (height: 33 cm; width: 158 cm) were used as a kick-off spot (starting point) to ensure that the players kicked the ball along the ground. The distance (50cm) from the ball to the kick-off spot was marked with a golf tee.

A free kick wall (see Appendix 7) (height: 1.60 m; length: 1.40 m; width: 0.70 m) was used as the target.

A video camera (Sony, Digital Handy cam, 120 xs, Japan) was used to film the participant's game-play.

Match analysis of video footage was undertaken using "Sports Code™ - Game breaker" (version 6.5.32) software.

Measures

The measures recorded for each player were as follows (see also Appendix 8):

- Date of birth (year);
- Playing experience (year/month);

- Height (m);
- Weight (kg);
- Lengths of lower limbs (cm);
- Step lengths (cm);
- Estimated kicking distance (m).

After height and weight measurements were taken, each child was required to kick a stationary football and then take part in a small-sided game. The distance and accuracy of each kick was measured as follows. Cones were set on the ground at the kick-off spot. A tape measure was used to measure the distance from the kick-off spot to the spot where the ball came to rest. This was recorded as the total kicking distance. In addition, the players had to aim for a target (free kick wall) placed 25 metres away from the kicker (kick-off spot.) The accuracy measurement made for each participant was the straight line distance from the ball to the centre of the target.

Procedure

Measurements and small-sided games took place on soft natural grass surfaces, according to the FIFA (2007) rules (LAW 1 – The Field of Play). Data collection took place in good weather conditions. The risks were minimal to the children and not deemed to be greater than those encountered during normal football practice. The health and safety protocols that are common prior to a 'professional level' coaching session were applied. For example, before the testing and playing, a thorough assessment of the playing surface was undertaken, to ensure no glass or other dangerous materials or surface irregularities existed.

The research was conducted at a football club in Auckland, which has a large number of child members. The research was part of the players (teams) weekly training sessions, which took place at the clubs facilities. This replicated the playing behaviour that children partake in at most New Zealand football clubs. Prior to a warm-up (light running, flexibility exercises, inside foot passing), the kicking task was demonstrated by the football club's Academy players (9 - 12 years of age). After the warm-up, participants were assigned to a series of three

instep kicks. Participants were instructed to take a one-step, angled approach of 45 degrees, to a stationary size 3, 4 or 5 football ball (based on age guidelines adopted by the football authorities), and kick the ball along the ground with the instep portion of the foot. Foot used was self-selected based on the player's response to which foot they prefer to use. There was approximately 90 seconds between kicks. Each participant was asked to wear their normal football boots.

After the kicking measurement procedure, the children were allocated to teams of 7 - 11 players per team, based on age guidelines adopted by the football authorities. Players were then asked to construct a small-sided game pitch according to the numbers on each team. The pitch dimensions were 'marked out' using coaching 'cones' and then measured. The pitch size used for comparison was the recommended regulation size of the club and United Soccer 1 (2005). The self-selected pitch size was determined based on the preference of the majority of the players. The teams played a 12-minute football game. After 6 minutes of this 12-minute game, the teams were asked, if they wish to change the playing dimensions of their pitch. Each player was asked this question individually (without the other players present) to reduce bias. Any changes to the playing dimensions were measured. Game-play footage was recorded on video for match analysis purposes. The camera was positioned 10 metres down the long side from the pitch.

Feedback to the participants was provided to individuals by request, and a summary of the research outcomes was provided through the participants' football club. Summary results and implications of research were delivered at a seminar/presentation to the club and participants involved in May 2008 at the Football Club (clubroom).

Data processing and statistical analysis

In line with the hypotheses proposed, the first portion of the analysis employed multiple regression analysis to explore correlations and variance explained in the kicking distance and kicking accuracy variables. The independent variables were height, weight, step lengths, estimated kicking distance, and limb anthropometrics. Data was explored and checked for outliers and distribution characteristics. Outliers were removed from the data according to two criteria:

value greater than three standard deviations from the mean or Mahanobis scores greater than 18.0. All data required a log10 transformation to improve distribution characteristics for regression. Alpha was set at 0.05 for both regression sets. Data for the second phase of analysis was generated using “Sports Codetm - Game breaker” (version 6.5.32) software, based on a 12 min sample of video for each game and age group.

Eight variables were set for categorical analysis. The second portion of the analysis required only chi squared statistics with alpha set at 0.05. All data was processed and analysed using SPSS version 14.0.

CHAPTER 5

RESULTS

The anthropometric and performance characteristics recorded for each player are shown in the tables (table 4 and 5) below.

Table 4: *The physical characteristics of the 8 – 14 year old football players*

	N	Minimum	Maximum	Mean	SD
Height (m)	98	1.20	1.82	1.44	0.10
Weight (kg)	95	24	66	37.8	7.7
Hip-knee lengths (cm)	97	22	52	34.0	5.3
Knee-ankle lengths (cm)	97	26	59	35.5	4.3
Step lengths (cm)	95	20	69	37.7	8.6

Table 5: *The performance characteristics of the 8 – 14 year old football players*

	N	Mean	SD
Playing experience (yrs)	98	2.8	2.6
Estimated kicking distance (m) *	86	31.1	16.8
Kicking distance (m)	94	18.0	6.6
Kicking accuracy (m)	96	8.3	4.4

* Being unsure of their ability, twelve players elected not to provide an estimate of kicking distance.

Correlations were employed in order to obtain an estimate of important relationships in the data.

Table 6: *Pearson correlation coefficients and sample size (N) of the physical characteristics and performance variables (kicking distance) of the football players*

	Kicking distance	Height	Weight	Hip-knee lengths	Knee-ankle lengths	Step lengths	Estimated kicking distance
	Pearson correlation value (n)						
Kicking distance		0.45 (85)	0.26 (83)	0.37 (84)	0.38 (84)	0.42 (83)	0.49 (74)
Height		-	0.78 (83)	0.73 (84)	0.86 (84)	0.55 (83)	0.48 (74)
Weight			-	0.62 (82)	0.72 (82)	0.48 (81)	0.42 (72)
Hip-knee lengths				-	0.64 (84)	0.62 (82)	0.51 (73)
Knee-ankle length					-	0.53 (82)	0.42 (73)
Step lengths						-	0.50 (74)

All correlations were significant at the 0.01 level. There are strong correlations between height and the other physical characteristics and both kicking distance and estimated kicking distance of the football players (see table 6).

Table 7: *Height and estimated kicking distance as predictors of kicking distance*

Predictors	R	95% confidence limits of R	R Square	Std. error of the estimate
Height	0.45	± 0.18	0.20	0.17
Height & estimated kicking distance	0.55	± 0.16	0.30	0.16

A spreadsheet designed by Hopkins (2007) was used to determine the 95% confidence limits of R^2 for possible predictor variables with a 0.1 Cohen's value used as the benefit/harm threshold. Regression analysis revealed that the best predictor of kicking distance was player height and their estimated kicking distance (see table 7). Player height explained 20% ($P < 0.000$) of the variability in kicking distance, whereas, height and estimated kicking distance together explained 30% ($P = 0.002$) of the variability.

Table 8: *Pearson correlation coefficients and sample size (N) of the physical characteristics and performance variables (kicking accuracy) of the football players*

	Kicking		Hip-knee	Knee-	Step	Estimated
	accuracy	Height	Weight	lengths	ankle	kicking
				lengths	lengths	distance
Pearson correlation						
	value (n)					
Kicking accuracy	-0.27 (85)	-0.13 (83)	-0.26 (84)	-0.27 (84)	-0.28 (93)	-0.37 (74)
Height	-	0.78 (83)	0.73 (84)	0.86 (84)	0.55 (83)	0.48 (74)
Weight		-	0.62 (82)	0.72 (82)	0.48 (81)	0.42 (72)
Hip-knee lengths			-	0.64 (84)	0.62 (82)	0.51 (73)
Knee-ankle lengths				-	0.53 (82)	0.42 (73)
Step lengths					-	0.50 (74)

There are strong correlations between step lengths and the other physical characteristics and with both kicking accuracy and estimated kicking distance of the football players (see table 8).

Table 9: *Step length and estimated kicking distance as predictors of kicking accuracy*

Predictors	R	95% confidence limits of R	R Square	Std. error of the estimate
Step lengths	0.28	± 0.21	0.08	0.23
Step lengths & estimated kicking distance	0.39	± 0.20	0.15	0.22

A spreadsheet designed by Hopkins (2007) was used to determine the 95% confidence limits of R^2 for possible predictor variables with a 0.1 Cohen's value used as the benefit/harm threshold. Regression analysis revealed that kicking accuracy (table 9) can be attributed to the influence of the player's step lengths (8.1%, $P = 0.016$) and both their step lengths and estimated kicking distance (15.1%, $P = 0.020$).

The results of game analyses are presented in table 10 (10th grade) and table 11 (9th grade). The numbers represent the number of passes made and the distances dribbled for both teams (14 players) per game.

Table 10: *Game 1: Game analysis of a 10th grade*, seven-a-side, football game (2 x 6 min) using a size 4 ball and different field dimensions*

	Standard field dimensions (50 m x 65 m)	Changed field dimensions (59.25 m x 65 m)	Total
Passing			
Long pass unsuccessful (Over 5m)	2	3	5
Long pass successful (Over 5m)	1	2	3
Short pass unsuccessful (0-5m)	8	7	15
Short pass successful (0-5m)	22	21	43
Total Passes	33	33	66
Dribbling			
Uncontrolled	3	4	7
Controlled (0-5 m)	6	8	14
Controlled (over 5+ m)	2	6	8
Total Dribbling	11	18	29

* Football players aged 9 to10 years.

Table 11: *Game 2: Game analysis of a 9th grade*, seven-a-side, football game (2 x 6 min) using a size 3 ball and different field dimensions*

	Standard field dimensions (30 m x 40 m)	Changed field dimensions (37.5 m x 40 m)	Total
Passing			
Long pass unsuccessful (over 5m)	6	7	13
Long pass successful (over 5m)	5	6	11
Short pass unsuccessful (0-5m)	9	12	21
Short pass successful (0-5m)	29	30	59
Total Passes	49	55	104
Dribbling			
Uncontrolled	5	4	9
Controlled, (0-5 m)	10	13	23
Controlled, (5+ m)	3	7	10
Total Dribbling	18	24	42

* Football players aged 8 to 9 years.

The 18.5% and 25% increases in field size for Game 1 and 2 respectively (see table 10 and 11) resulted in a greater amount of dribbling (63% more) in Game 1 and a greater amount of dribbling (33% more) and passing (12% more) in Game 2.

Chi squared analyses failed to indicate statistically significant differences in passing and dribbling behaviour between the two pitch sizes, in either age group. However, trends in the data might suggest a larger sample period would support significant differences.

The responses from the children regarding a preference for the larger pitch size can be grouped into the six main reasons shown in table 12.

Table 12: *Why children preferred larger pitch dimensions?*

Response
1. More fun
2. More space
3. More through balls
4. More one-two's
5. Able to take free kicks from further back
6. More running

While the children responded that they preferred the larger pitch sizes, interestingly, the video analysis and the research team's observations showed that the extra field area went unused. Game-play still took place within the standard field dimensions.

CHAPTER 6

DISCUSSION

The aim of the current investigation was to examine variables that specifically influence actual kicking distance and accuracy and to measure the differences in play behaviour (passing and dribbling) that emerge from self-selected changes in pitch size. From a practical viewpoint, we wanted to examine the relationship between the size of the pitch and the kicking ability (distance and accuracy) of young children (8 - 14 years of age). It was predicted that an increase in age, step length, lengths of lower limbs, height, weight, and estimated kicking distance would predict an increase in actual kicking distance. It was also expected that with a change in pitch size, the number of passes (e.g., successful short passes over 0-5m) made would increase and the distances dribbled (e.g., successful dribbling over 0-5m) would decrease (in particular for the age group 9 and 10 years of age).

The key findings of this study were that kicking distance is best predicted by a player's height (20.0%) and a combination of their height and estimated kicking distance (30.0%) (see table 7). Kicking accuracy can be attributed to the influence of the player's step lengths (8.1%), and both their step lengths and estimated kicking distance (15.1%) (see table 9). Furthermore, our results demonstrate that, with a larger pitch size (see table 10 and 11), the number of long and short passes (successful and unsuccessful) and the number of controlled dribbles over 0-5m and over 5+m (e.g., table 11) increased. The increases (see table 10 and 11) in pitch size (18.5% and 25%) resulted in a greater amount of dribbling (63% and 33% respectively) and passing (12% increase in Game 2).

Our findings are in line with those of Owen (2005) and Williams and Reilly (2000), who indicated that a player's anthropometric characteristics (e.g., height, step length) are related to their performance, in important ways (e.g., taller players are more likely to score goals with headers). For example, our data showed a high correlation between the player's height ($P < 0.000$), step length ($P = 0.016$) and their kicking ability (distance and accuracy) (see table 7

and 9). Furthermore, our game analysis (see table 10 and 11) showed that through the increase in field dimensions, differences in play behaviour (e.g., controlled dribbling) occurred. These findings support anecdotal reports from players and coaches that field dimensions affect the movement patterns of children (e.g., Rampinini et al., 2007).

However, when we compared our results with previous guidelines from the USA and from the literature (e.g., US Youth Soccer, 2007; Singleton, 2006; Lee, 1993), we concluded that although there were similarities (e.g., smaller fields are better suited to the kicking ability of youth players), fundamentally our findings were very different. In particular, our data did not support their view that the size of the pitch should be based on the size of the step for each age group relative to adults, or on chronological age. Significantly, our findings showed that height and estimated kicking distance appear to be better predictors of kicking distance in youth players and therefore pitch sizes should match these developmental capacities and limitations.

Although we have demonstrated that there is a relationship between a player's height, step length, estimated kicking distance and kicking ability (distance and accuracy), care must be taken when interpreting the present results as they are based on club players from different age groups, experience levels and teams. It is acknowledged that the participants had different technical skill levels (e.g., side foot pass, controlled dribbling), which may have affected our data analysis. It is possible that fitter players or players of a higher technical standard would benefit from larger pitch dimensions.

Interestingly, most of the participants (9 and 10 years of age) in this study preferred larger pitch dimensions (see table 10 and 11). In particular, the players in this age group wanted to change the width (see table 10 and 11) of the field. The players expected that they would have more fun, more space, more through balls, more running and could take free kicks from further back on a wider pitch (see table 12). However, our video analysis and observation showed that players did not use the additional field space. It may tentatively be argued that despite an explicit desire to play in a larger space, implicit factors

actually determined the characteristics of children's play. Game-play still took place within the standard pitch dimensions. General observation suggests that they picked a larger space but failed to make good use of that space in subsequent play. They largely occupied the same space as before. However, it is clear from the evidence (see table 10 and 11) that the passing/dribbling behaviour changed with pitch size. Crucial to passing/dribbling behaviour is the distance between players in the same team (team-mates) and the total number of players on the pitch at a given time. The distances between players might interfere with a critical pass or run/dribble decision. If players are too far apart, they will not pass the ball and the number of attempts at transporting the ball will increase. It is noteworthy that the data was not sufficient to test fully the 'beehive effect' (e.g., page 6), in terms of inter-player distance.

We should make clear that in asking players to mark out a new pitch size we expected them to select a smaller one. The manipulation of pitch sizes to smaller fields (small-sided games) is the fastest growing trend in youth football around the world (e.g., Australia, Germany) (Lynch, 2007; Singleton, 2006). In addition, these small-sided games are one of the most common strategies used by coaches for football training (e.g., Rampinini et al., 2007). Whereas in the past, small-pitches were mainly used for developing technical abilities, they are now employed by many amateur and professional teams as an effective tool to stimulate physiological adaptation and performance improvement (e.g., Impellizzeri et al., 2006). Several factors have been suggested that influence small-sided games. These include the dimensions of the pitch, the number of players on each side and the rules adopted (e.g., Rampinini et al., 2007). For example, researchers at Manchester United Football Club (in England's top professional league) pointed out that the use of small-pitches meant that the young players were required to perform a greater number of skills (such as the number of shots, passes, and one-on-one challenges) resulting in rapid technical and tactical development of the players (SPARC, 2007). Additionally, players are required to make more decisions, run more and experience game situations more frequently. This highlights a clear difference between theory and game related developments at the higher level and perceptions of game play at a recreational (social) level. It is unclear whether this misperception occurs as a

consequence of the way in which the game is being explained, or the differences in the way in which play is perceived both implicitly and explicitly.

In New Zealand, junior players are grouped by their chronological age. The player's age on their birthday during the current season's calendar year (1 January to 31 December inclusive) determines the grade for that year, e.g., a 10th Grade player turns 10 years of age during the calendar year (United Soccer 1, 2005). A player may only 'play up' (e.g., a 10 year old player plays 11th grade) one grade in the 9th to 14th Grades inclusive and must have the written approval of the Leagues Manager, in consultation with New Zealand Football, if applicable (NZS, 2006). However, we found significant differences (Appendix 9) in the technical kicking ability (e.g., distance and accuracy) within the same age groups. Such large differences in kicking distance and accuracy may reflect the difficulties in using chronological age to indicate stages of development (e.g., Cote & Hay, 2002). Additionally, in youth football, the potential movement solutions available to children are strongly determined by the fit between their environment and their current stage of development (e.g., Renshaw, in press). For example, a young football player who is required to take a shot (kick) at a full size goal, on a full size pitch with a full size ball, will result in a movement solution that does not reflect that of an adult shooter. If it is important for children to replicate the movement patterns of adults, then it is important to scale equipment (e.g., ball size) and task environments (such as the size of the playing area) to the developmental stage of the player, as opposed to chronological age (e.g., Renshaw et al., in press). In seeking to develop a "passing game", the goal is to transport the ball through the middle 30 - 40% of the field on the ground and not in the air. The distance the ball has to cover in order to meet this constraint in the adult game is approximately 35 m. This would require approximately two touches from adult players but three or more from juniors, based on the data gathered here.

Until players are able to produce a co-ordinated kicking action (movement pattern), it could be argued that they are not ready to play 'organised' competitive games. If players (young children) cannot kick the ball a reasonable (e.g., 30 - 40% of the pitch length) distance with relative accuracy, it would

suggest that playing 'large team' games on a full size pitch is not appropriate. Furthermore, Lee (1993) and Williams (2000) suggested that players below the age of 12 are not fully able to process information in the same way as adults. In fact, it is likely that players of this age are not thinking in terms of more than 3 - 4 players around them, at any one time. Therefore, we recommend 'activities' that involve 'kicking/passing' games or 'dribbling' games prior to playing organized/structured competitive games for 9 and 10 year old players. These 'kicking/dribbling' games do not have to be highly structured, in fact there is much evidence to support 'play practice' (free play) in the early development of players. For example, young South American players receive no structured coaching until 16 years of age and are generally accepted as the most creative and technically proficient players in the world (e.g., Ericsson, 2003; Payne, 2007).

Consequently, any attempt to identify the best age-matched pitch size for children must account for their physical and psychological maturation and their skill level (e.g., Williams & Reilly, 2000). Perceived and absolute kicking ability (e.g., distance and accuracy) are likely to have considerable influence on the style (e.g., long ball game, passing game) of play and therefore the enjoyment of age-group play. By adapting the field dimensions to children's physical (e.g., height) and technical kicking ability (e.g., distance, accuracy) instead of their chronological age, football in New Zealand would allow children to approximate more closely the movement patterns of adult players and hence the techniques of the game (e.g., Savelsbergh et al., 2004).

In practical terms, this means that coaches should not force all children to try to fit the perfect movement templates often highlighted in textbooks, as the one way of performing a movement. In general, as long as the biomechanical principles of the movement are sound and the movement is not going to cause injury, good coaches allow their athletes to solve problems in ways that are best suited to their own individual constraints (e.g., Davids et al., 2007). Thus, any 'coaching' at this level should endeavour to create environments that allow players the opportunity to explore and solve problems (Renshaw, Oldham, Glazier, & Davids, 2004). Furthermore, the coach is critical to the grouping of

players, as objective measurement of young player's potential is fraught with difficulties and, as a consequence, assessing a player's ability (and potential) involves a high level of subjective assessment (e.g., Williams & Reilly, 2000). Clearly, this practical point highlights the importance of developing ways of objectively assessing young players. It also highlights the importance of coach education to ensure that coaches have sufficient awareness and knowledge of development issues.

Our findings suggest that performance environments in New Zealand need to be carefully replicated during practice and training so that athletes can learn to detect affordances for action and to use these sources of information to regulate their movements (e.g., Davids et al., 2007). Children's football training should therefore match the game situation as closely as possible (e.g., Savelsbergh et al., 2004). The perceived information from the task constraints (pitch sizes), together with the intention of the player (young child), will accentuate the overall variations in decision-making (i.e., to pass the ball on the first touch, or to dribble the ball away from opponents). This manipulation of task constraints would lead to the performers (young children) having to make quicker decisions and to develop more precise control and passing/dribbling skills. These task constraints can be simplified by reducing the number of players in teams or by reducing the size of the playing area, rather than reducing skills to practice in static drill activities that are not relevant to game situations (e.g., Renshaw et al., 2006).

The findings of this thesis have several implications regarding coaching, pitch sizes and the grouping of players in New Zealand. First, pitch size is an integral variable in constraints-led sports performance and learning. Changes in organism constraints (e.g., growth and development) have implications for the acquisition of ball skills in children, particularly in relation to equipment design (e.g., ball size) and coaching practices (e.g., reducing the size of the playing area). Therefore, coaches should have a basic understanding of the constraints-led approach so that they can manipulate key factors such as pitch sizes and number of players.

Second, pitch sizes will determine distance between players on the field at the

start (and re-start) of game-play, which is often greater than the perceived kicking efficacy of younger players (Huddleston & Huddleston, 2007). Using a large size field and goals makes little sense for children because it does not reflect their skill level, kicking ability and physical development stage (e.g., Singleton, 2006; US Youth Soccer, 2007). To play on a large pitch changes the nature of the game for children because playing areas will determine the presence or absence of a passing game and the incidence of the 'beehive effect'. For example, if players are too far apart they cannot pass the ball and the number of attempts at transporting (dribbling) the ball will increase. This will result in a corresponding bunching of players in a small portion of the pitch ('beehive effect'). Consequently, the game develops inappropriately.

Third, it is important that pitch sizes in New Zealand are not overly biased towards the early maturing child (e.g., Williams & Hodges, 2005). In line with other sports (such as tennis and rugby union) football administrators in New Zealand should attempt to 'body scale' pitch dimensions to suit the needs of the 'smaller' children, enabling them to play a game that is reflective of the adult game (e.g., Lee, 1993). No longer would the person who is the tallest, can kick the furthest or can run the fastest dominate the game. Players who are slow to develop physically would not have as much of a disadvantage. Children who make good decisions but currently lack physical strength, would be given an equal field to play upon. This should result in developing more and better football players in New Zealand, allowing those late developers a chance, while forcing early physical developers to focus on becoming football players, not football athletes (e.g., Helsen et al., 2000). Children would be encouraged to develop decision-making skills rather than rely on physical attributes. A key factor would be the grouping of youth players according to their physical (e.g., height) and technical kicking ability (e.g., distance, accuracy) instead of their chronological age.

The current research aimed to provide guidelines for football pitch sizes which are developmentally appropriate, in order to allow more children to be involved in the game. We argued that the pitch needed to be small, but not so small that motor development and play behaviour were detrimentally constrained in other regards. This target has not been fully met because the issue was more

complex than originally thought and we failed to consider a combination of interacting constraints that determine important game related issues. For example, the interaction between logical space and the number of players occupying it (more players in a smaller space are likely to interact with passing decisions). Consequently, further research is needed in order to make the intended recommendations. Furthermore, the present results suggest that attention should be drawn to the biomechanical movement pattern of any technical kicking (e.g., passing) task. In retrospect, the author also feels that player numbers was an important consideration overlooked in the design of this study.

Where to from here?

Future Research Directions

More research is required to investigate the difference between current practice and theoretically driven concepts of football pitch sizes for children. To test the findings and their practical applicability in actual game play, a larger sample of football playing children is required. Data collection should be made during competitive games, instead of trainings games and chronological age should be measured more accurately.

Further research could include the following:

- Examination of three different age groups of equivalent skill level and assess their performance in relation to their kicking ability on two different pitch sizes: standard (as per federation guidelines), and smaller (anecdotally we would recommend 10 - 20% smaller than the standard size). Including analysis of individual players and mean distances between players in the same team (team-mates) during game play need to be considered ('beehive effect').
- Manipulation of the number of players in order to see if this factor affects competitive game-play. With smaller numbers of players, all players would be exposed to solvable situations more often (e.g., the pass/dribble decision).

Practical Implications

An important follow up to this thesis should be the dissemination of the findings to the football community (e.g., coaches, administrators) in New Zealand. Clearly, the findings of this thesis will have important implications that could enhance the effectiveness of coaching, game-play (competition) and consequently performance at junior levels in New Zealand. In particular, the implication for the grouping of young players in New Zealand needs to be discussed, including the current 'playing up' rule. Ideally, coaches, parents, and football federations should share the desire to provide equal opportunity for all participants. At the present time however, where advanced physical development (e.g., height) is an advantage, the youngest players (biologically and chronologically) are considerably disadvantaged. Not only does the physical size of the participants influence the dimensions of ideal playing areas, but so also do the limitations of physiological development (Lee, 1993). Many 'talented' children in New Zealand may be overlooked simply because they are less developed physically (e.g., Williams & Hodges, 2005). Perhaps the issue is that age and development are conceptually distinct; that is, developmental processes are age-related but not age-dependent (e.g., Cote, 1999).

Summary and Conclusion

In summary, this research has provided some clear and integrated findings (e.g., kicking distance increases as the height of children increases; passing and dribbling behaviour is affected by pitch size) that are associated with effective pitch sizes for children playing football in New Zealand. This paper investigated how variables (such as height, step length, dribbling, and passing) influence kicking distance, kicking accuracy and game-play. Our observation confirmed that team ball sports such as football are complex in nature, with evidence of anthropometric, physiological, psychological, perceptual, and technical contributions to performance (e.g., Hoare & Warr, 2000). In addition, football performance requires the application of a wide range of technical skills (e.g., passing, dribbling). It requires players to have advanced perceptual skills (to be able to read the game), and to have game understanding and be able to utilise the right skills in the right place at the right time (e.g., Williams & Reilly, 2000). Consequently, any attempt to identify the best pitch sizes for children

must take into account these multiple factors, together with the influence of growth and maturation across the development cycle (e.g., Williams & Reilly, 2000). Coaches should encourage junior players to solve problems using techniques that are most suitable to them individually (e.g., Davids et al., 2006; Williams & Hodges, 2005).

In conclusion, our results support the idea that pitch dimensions for children in New Zealand should be based on technical kicking ability (e.g., distance), passing skill (e.g., accuracy) and height rather than on chronological age. The reduction of pitch sizes can lead players to make quicker decisions, have more possession of the ball, and to develop more controlled kicking and passing skills (e.g., Bunker & Thorpe, 1982; Singleton, 2006). Therefore, a key recommendation for governing bodies in New Zealand is to explore a reduction in the age range of the age groupings and closer matching of players into groups based on their technical kicking ability and physical height rather than chronological (e.g., Barnsley & Thompson, 1988, as cited in Helsen, et al., 2000). Young children in New Zealand should be playing on a pitch and at a level which matches their football abilities. A change in mentality, grouping youth players on a pitch according to their physical and technical ability instead of their chronological age, seems to be the key factor to any other set of proposals.

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APPENDICES

Appendix 1: Soccer Field Size (US Youth Soccer, 2007)

Age Group	Game Length	Field size (yards)	Number of players
Under 12	Two 30' halves	110 x 60 yards	No more than 11, 8 strongly recommended
Under 11	Two 30' halves	100 x 50 yards	No more than 11, 8 strongly recommended
Under 10	Two 25' halves	60 x 40 yards	No more than 7, 6 strongly recommended
Under 8	Four 12'quarters	45 x 30 yards	No more than 5, 4 strongly recommended
Under 6	Four 8'quarters	40 x 25 yards	No more than 4, 3 strongly recommended

Appendix 2: Ethics Approval



MEMORANDUM

Auckland University of Technology Ethics Committee (AUTEC)

To: Tony Oldham

From: **Madeline Banda** Executive Secretary, AUTEC

Date: 20 June 2007

Subject: Ethics Application Number 07/41 **To determine the ideal competition pitch size for young children playing soccer.**

Dear Tony

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC) at their meeting on 16 April 2007 and that the Chair of AUTEC approved your ethics application on 12 June 2007. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTEC's meeting on 9 July 2007.

The Chair noted that the Information Sheet for the children could still be simplified even further and that more appropriate language for children of the age concerned as well as pictures would improve it. If you choose to do this, you should provide the Ethics Coordinator with the revised Information Sheets for approval before their use.

Your ethics application is approved for a period of three years until 12 June 2010.

I advise that as part of the ethics approval process, you are required to submit to AUTEC the following:

- A brief annual progress report indicating compliance with the ethical approval given using form EA2, which is available online through <http://www.aut.ac.nz/about/ethics>, including when necessary a request for extension of the approval one month prior to its expiry on 12 June 2010;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/about/ethics>. This report is to be submitted either when the approval expires on 12 June 2010 or on completion of the project, whichever comes sooner;

It is also a condition of approval that AUTEC is notified of any adverse events or if the research does not commence and that AUTEC approval is sought for any alteration to the research, including any alteration of or addition to the participant documents involved.

You are reminded that, as applicant, you are responsible for ensuring that any research undertaken under this

approval is carried out within the parameters approved for your application. Any change to the research outside the parameters of this approval must be submitted to AUTEK for approval before that change is implemented.

Please note that AUTEK grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this. Also, should your research be undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply within that jurisdiction.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all written and verbal correspondence with us. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at charles.grinter@aut.ac.nz or by telephone on 921 9999 at extension 8860.

On behalf of the Committee and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely



Madeline Banda

Executive Secretary

Auckland University of Technology Ethics Committee

Cc: Heinz-Willy Gerdson anjawill@slingshot.co.nz

Appendix 3: Parent/Guardian Consent Form

Project title: To determine the ideal competition size for young children playing football.

Researcher: Willy Gerdson

- ☐ I have read and understood the information provided about this research project.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that I may withdraw my child/children or any information that we have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If my child/children and/or I withdraw, I understand that all relevant information, or parts thereof, will be destroyed.
- ☐ I agree to my child/children taking part in this research.
- ☐ I give consent for the confidential information collected in this study to be used by AUT for research purposes, with the understanding that I will remain anonymous.

Child/children's name/s :

.....
.....

Parent/Guardian's

signature:.....

Parent/Guardian's name:

.....

Parent/Guardian's Contact Details (if appropriate):

.....
.....

Date:.....

Appendix 4: Consent Form

Parent/Guardian Consent Form



Project title: To determine the ideal competition size for young children playing football

Project Supervisor: Dr. Tony Oldham

Researchers: Bob Jarman, Willy Gerdson, Dr. Ian Renshaw.

- ☐ I have read and understood the information provided about this research project.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that I may withdraw my child/children or any information that we have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If my child/children and/or I withdraw, I understand that all relevant information, or parts thereof, will be destroyed.
- ☐ I agree to my child/children taking part in this research.
- ☐ I give consent for the confidential information collected in this study to be used by AUT for research purposes, with the understanding that I will remain anonymous.

Child/children's name/s :

.....

Parent/Guardian's signature:

Parent/Guardian's name:

Parent/Guardian's Contact Details (if appropriate):

.....

.....

.....

.....

Date:

Approved by the Auckland University of Technology Ethics Committee on 12 June 2007, AUTEK Reference 07/41

Note: The Participant should retain a copy of this form.

Assent Form

Project title: To determine the ideal competition pitch size for young children playing football

Project Supervisor: Dr.Tony Oldham

Researchers: Bob Jarman, Willy Gerdson, Dr. Ian Renshaw.

- ☐ I have read and understood the sheet telling me what will happen in this study and why it is important.
- ☐ I have been able to ask questions and to have them answered.
- ☐ I understand that notes will be taken during the study and that they will also be video-taped and transcribed.
- ☐ I understand that while the information is being collected, I can stop being part of this study whenever I want and that it will be okay for me to do so.
- ☐ If I stop being part of the study, I understand that all information about me, including the recordings or any part of them that include me, will be destroyed.
- ☐ I agree to take part in this research.

Participant's signature:

Participant's name:

Participant Contact Details (if appropriate):

.....

Date:

Approved by the Auckland University of Technology Ethics Committee on 12 June 2007, AUTEK Reference 07/41

Note: The Participant should retain a copy of this form.

Appendix 5: Letter to the club

Re: Determining the ideal competition pitch size for young children playing football in New Zealand.

A team of researchers from the Division of Sport and Recreation, Akoranga Campus, Auckland University of Technology are seeking to recruit a total of 240, and 60 boys and girls who play football in your club to assist in the above study into child football.

One of the researchers will contact you within the next few days to discuss the project aims and process of collecting the data for the study. Up to sixty players in the following grades: Grade 7/8, grade 9/10, grade 11/12, and grades 13/14 are required to complete the data collection. The number of players will be drawn from a number of clubs in the North Shore area. The project needs to be completed before April 2008, which entails data collection to be some months (preferable September 2007) before this deadline.

The project requires a number of measurements related to football. These are:

- Date of birth;
- Playing experience;
- Height;
- Weight;
- Kicking distances.

The procedure will be as follows:

- The players will be asked to estimate and perform football kicking with a stationary ball;
- The players will be selected for a team to play in a 12-minute small-sided game (based on age grouping similar to the club grading);
- The players in each game will be asked to construct a pitch size based on their team size;

- The players will be asked after 6 minutes play if they wish to modify the size of the pitch;
- A brief recording of video footage for match analysis purposes.

The research will take approximately 1-hour of both the players and the players' parent/caregivers. The caregivers and/or coaches are required to stay at the venue during the whole of the measurement process. Parents/caregivers and the children will be asked to give their consent before the data collection can take place.

The club will have an opportunity to receive feedback on the results of this research project by requesting a summary of the report in a seminar.

Appendix 6: Participant Information Sheet

Date Information Sheet Produced: June 2007

Project Title: To determine the ideal competition pitch size for young children playing football.

Invitation

You are invited to take part in a study to decide the ideal pitch size for young children playing football in New Zealand.

What is the purpose of the study?

The purpose of this study is to see if the size of football pitches needs to change according to how old you are or how tall you are.

How have you been chosen to be asked to be part of the study?

You have been selected because you play football in your local club.

What happens in the study?

A number of measurements will be written down. We will ask you how long you have been playing football. We will measure your height and weight. You may be asked to guess how far you can kick a ball and we will give you a go at kicking a stationary football ball. We will measure how far you can kick a ball and how close you get to a target. You will be asked to join a team for a 12-minute small-sided game (you will be in a team with players of similar age to you). The players in your game will be asked to mark out a pitch size using 'cones' and we will measure the size of the pitch you set up. You will be asked after 6 minutes play if you wish to change the size of the pitch. We measure any changes you make. We will video play for a short period of time to see what happens on different sized pitches at different times. We have asked your parents for your date of birth so that we can put you in the right team.

What are the discomforts and risks?

As you will be performing football games similar to your usual Saturday matches and doing simple kicking tasks, the risks and discomforts should be no more than in a normal Saturday game.

What are the benefits?

The copy of the final report will be sent to the sport's ruling association in Auckland with recommendations on the appropriate size of pitches to help you develop your football skills. It is hoped that this research will make playing football more fun and skilful for younger age groups.

How will my privacy be protected?

We will lock all the forms given to you and the measurements recorded on paper in a storage area for six years at Auckland University of Technology and then the paper will be destroyed. Any reports will avoid naming you and your club. Video recordings will be seen only by the researchers and kept in a locked place until they are destroyed.

How do I join the study?

By your parent/caregiver completing a consent form and by you agreeing to take part.

What are the costs of participating in the project? (Including time)

No money costs, approximately one hour of you and your parent/caregiver's time. Your parent/caregiver has been asked to remain nearby to watch you and collect you at the end.

Opportunity to consider invitation

You can stop at any time up to end of the measurements and games.

Appendix 7: Freekick Wall



Appendix 8: Research Project Form for each player

Testing –2007

1. Name: _____

2. Participant no.:

3. Consent/Assent form: yes/no

4. Information sheet received: yes/no

5. Playing experience: _____ years

6. Date of birth: ____ ____ ____ age: ____ years
 day month year

Measurement

7. Height: ____ m ____ cm

8. Weight: ____ kg

9. Dimensions of lower limb:

9.1. _____ (hip/knee)

9.2. _____ (knee/ankle)

10. Step stride: -----(cm)

11. Estimated kicking distance; -----(m)----- (cm)

12. Additional Info:

Appendix 9: Contents of CD

The CD contains excel files showing the raw and analysed data for the study.