Individual factors that influence children's engagement on the school playground

by

Christopher E. Lim
BKIN, University of British Columbia, 2012

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Supervisory Committee

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Abstract

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Only one third of children and youth meet current physical activity (PA) guidelines. Low levels of PA can impact future PA, the probability of obesity, and delay fundamental motor skill (FMS) development. One environment associated with children's PA is the school playground. Limited research has explored how motor skill development and other child level factors may influence playground behavior.

The purpose of this study was to explore playground behaviour and determine if children's motor skills predicted playground behavior (e.g. enjoyment, frequency, intensity and type of play). A secondary objective was to explore whether other individual level variables influenced these playground behaviours (e.g. sex, physical activity, strength).

All grade 2 and 3 children from one school were recruited to participate in this cross-sectional mixed-methods study. Information about PA was collected using the Physical Activity Questionnaire for Children and the Children's Assessment of Participation and Enjoyment. Playground behavior information was collected using the Playground Enjoyment Questionnaire. The Test of Gross Motor Development - 2 and the stork stand were used to assess FMS and a handheld dynamometer assessed grip strength. Descriptive statistics and a one-way analysis of variance were calculated to determine if children's PA differed between playground areas and sex. Pearson product moment correlation coefficients examined associations among children's individual factors and

playground play. Linear regression examined if children's FMS and significant individual correlates predicted playground engagement.

A total of 54 children with a mean age of 8.46yrs (*SD* = 0.68) participated. The sample included 31 boys (*M* = 8.48yrs of age (*SD* = 0.73) and 23 girls (*M* = 8.43, *SD* = 0.59). Correlation coefficients revealed that FMS were not significantly related to children's playground engagement. Boys frequented the field more than girls (F (1, 52) = 5.18, p = .027), enjoyed the field (F (1, 52) = 4.07, p = .049), the courts (F (1, 52) = 6.74, p = .012) and the nature space (F (1, 52) = 4.19, p = .046) more than girls. Object control skills negatively predicted built structure play frequency (B = -.267, t = -2.39, p = .022). Gross motor quotient predicted the type of activities children engaged in the built structures (B = .055, t = 2.178, p = .035). Children's overall PA positively predicted their play frequency, intensity, and enjoyment in court areas and intensity in the field. Grip strength predicted enjoyment in field areas. Recreational PA level negatively predicted play frequency on tarmac areas.

Although, children's FMS rarely predicted where and how children engaged on school playground spaces, other child factors (i.e. sex, PA, and grip strength) did. Children's self-reports showed that friends also influenced their play behaviours. FMS development did not have a significant impact on where or how children played on the playground, which suggests that children of varying FMS may engage in the same play spaces. In the context of the ecological model there were child level factors that influenced their interaction with the playground as a micro-environment which requires further investigation.

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Acknowledgments

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Dedication

To my mom, my dad, and my friends I could not have done this without all your love, support, and encouragement. Thank you for everything!

Chapter 1: Introduction

1.1. Overview

Canada's 24-hour movement guidelines recommend that children and youth achieve at least 60 minutes a day of moderate to vigorous physical activity (MVPA) (Canadian Society for Exercise Physiology, 2016). Only one third of children and youth have met the current PA guidelines between 2009 and 2013 (Colley et al., 2011; Roberts et al., 2017). A lack of PA during childhood is shown to decrease the probability of adequate PA in adolescence and increase the probability of both obesity and less than optimal fundamental motor skill (FMS) development (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008; D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; Dollman, Norton, & Norton, 2005; Goran, Reynolds, & Lindquist, 1999; Trost et al., 2002). Conversely, the development of FMS during childhood has been linked with participation in PA during adolescent years (Barnett et al., 2008).

Stodden et al. (2008) suggests that there is a bi-directional relationship between FMS and PA and this relationship can change over time. This relationship emphasizes the importance of children being physically active when they are younger in order for them to develop and practice their motor skills (Stodden et al., 2008). If children have had the opportunity to practice their motor skills when they are young they will likely be more physically active (Stodden et al., 2008). Many studies have examined the relationship between FMS and PA during childhood supporting Stodden et al.'s (2008) assertions that FMS and PA influence one another (Holfelder and Schott, 2014). Okely, Booth, and Patterson (2001) and Wrotniak, Epstein, Dorn, Jones, and Kondilis (2006) examined the FMS of children in grades 8 to 10 and children aged 8-10 years. Their respective analysis revealed that children's time spent in PA related to higher levels of motor skill proficiency. The main difference in the findings regarding the relationship between

PA and motor skill proficiency was that Okely et al. (2001) examined FMS related to organized PA, whereas for Wrotniak et al. (2006) FMS related to overall PA. Similarly, Crane, Naylor, Cook, and Temple (2015) found a direct relationship between children's (M = 5 years and 7 months) PA and object control skills. Field and Temple (2017) also found a relationship for between motor skills and children's participation in organized sports and active recreation. Field and Temple (2017) further revealed that girls' locomotor skills were correlated with their participation in gymnastics and boys' locomotor and object control skills were correlated with intensity of participation in team sports. The inter-relationships between FMS, PA, and recreation/sport suggests that examining settings and activities that may either encourage or discourage participation is important.

The school playground is an important setting to afford opportunities for children to be physically active because playgrounds serve children of diverse backgrounds, they provide a location for play, and significant time (approximately one hour/day) is spent there during the school day (Fox, 2004; Fox, Cooper, & Mckenna, 2004; Haug, Torsheim, Sallis, & Samdal, 2010; Heusser, Adelson, & Ross, 1986; Janssen, Toussaint, Van Willem, & Verhagen, 2011; Marshall & Hardman, 2000; Ridgers, Fairclough, & Stratton, 2010a; Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). Several interventions have attempted to increase PA on the school playground. These interventions included adjustments to playground markings, new designs or renovations, facilitation by teachers, and the addition of loose equipment (Blaes et al., 2013; Cardon, Labarque, Smits, & De Bourdeaudhuij, 2009; Engelen et al., 2013; Hannon & Brown, 2008; Stratton, 2000). Most of these previous studies (e.g. Stratton, 2000, Blaes et al., 2013) have shown the impact of playground modifications at increasing PA over a short period of time, but only a couple have studied this over the longer term (i.e. over a 12 month period) and have

not demonstrated sustained behavior change (Engelen et al., 2013; Ridgers et al., 2010a). It may be that these infrastructure changes are only one part of the picture.

It has previously been suggested that both children's motor skills (an individual factor) and playground design could influence children's PA and engagement on the playground (Barbour, 1999). Barbour's examination of playground design suggested that children's engagement varied based on their competence, motor skill abilities, and their access to different playground features. In fact, Gallahue, Ozmun, and Goodway's (2012) Lifespan Model of Motor Development incorporates a transactional model of causation that highlights the influence of task requirements, and the environment and individual level factors on motor development. This is supported by ecological models which suggest that individual behavior is influenced through reciprocal interactions between individuals and the micro, meso, and macro environments where they spend time (Bauman et al., 2012; Brofenbrenner, 1999). Stodden's model of motor development also suggests that relationships between motor skill development and PA are mediated by health-related fitness, individual constraints, environmental constraints, and motor constraints (Stodden et al., 2008).

With the association between FMS and current and future PA established, it appears that further research is needed to understand how children's playground behavior (use of areas, type of play, intensity and enjoyment) is associated with FMS and PA (individual level factors), as well as understanding how other individual factors such as sex, and strength may also influence PA engagement on the playground.

1.2. Purpose of the Research

The purpose of the research was to examine the relationship between individual factors (motor skill competence, current participation in PA (total and recreational), sex, and strength)

and school playground play behavior, as seen in Figure 1. Specifically, this research examined: 1) where children played and their intensity, type of play, and enjoyment in different playground areas and if this differed by high and low motor skill development or sex and 2) how their motor skill development, current participation in PA (total, and recreational), sex and strength related to and predicted where and how (frequency, intensity, type and enjoyment) they engaged on the playground.

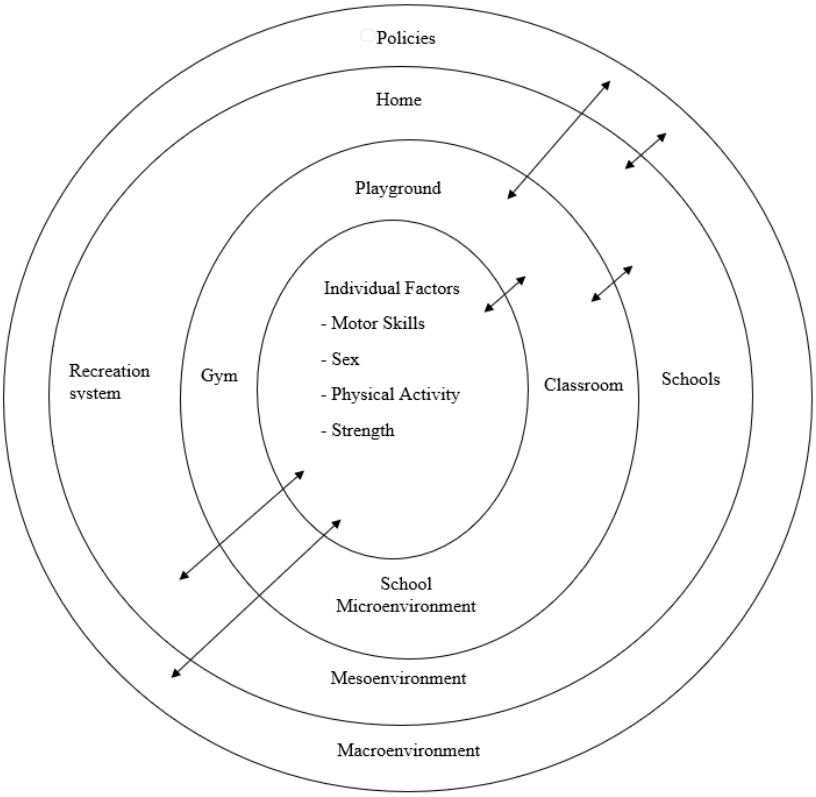

Figure 1. An adapted socio-ecological model incorporating the playground as a micro environment and illustrating potential individual level factors that may influence playground use

1.3. Research Questions

1) Did children's play behavior (frequency, intensity of PA, enjoyment, and type of play) vary on different locations on the school playground? Did this differ by motor skill abilities or sex?

2) Did children's motor skills, sex, PA, and grip strength relate to where (area) and what children were doing (frequency, intensity, enjoyment, and activity type) when they engaged on the school playground?

3) Did motor skills, strength, PA (overall and recreational), and sex predict playground behavior in different locations?

1.4. Definitions

1) Children: Boys and Girls 6 – 9 years of age.

2) Playgrounds: The location available on school grounds for children to engage in any form of play (Herrington & Lesmeister, 2006; Veitch, Bagley, Ball, & Salmon, 2006), including covered and non-covered areas. The school play space includes fields, courts, built play structures, nature spaces, and tarmac spaces.

3) Fundamental Motor Skills (FMS): Basic organized motor movements, considered to be the building blocks that are necessary to develop and learn more complex motor skills (Gallahue & Donnelly, 2003; Kirchner & Fishburne, 1998). For this study the skills were classified into three categories: locomotor, object control, and stability (Gallahue & Donnelly, 2003). Locomotor and object control skills were defined based on the Test of Gross Motor Development – 2 (TGMD-2) (Ulrich, 2000). Therefore, locomotor skills were composed of six skills: run, gallop, hop, slide, horizontal jump, and leap and represented as a total score. Object Control skills were composed of six skills including: dribble, catch, throw, strike, overhand throw, and underhand roll. Although, stability can be defined as both static and dynamic balance, only static balance was

examined and measured as time spent in the stork stand (Gallahue & Donnelly, 2003; Kirchner & Fishburne, 1998; Wagner, Kastner, Petermann, & Bös, 2011).

4) Break Periods: Also known as recess, was defined as the time provided to children during school hours that allowed them to engage in non-curriculum activities and play (Ridgers, Stratton, & Fairclough, 2006)

5) Playground Use: Referred to both the location where children engaged on the playground and the type of structures that they were engaging with. Specifically, it referred to the area where children reported playing (and the associated structures if present) and the frequency, intensity and enjoyment they reported while playing there.

6) Strength: Strength for the purposes of this study is represented by hand grip strength children achieve using the handheld dynamometer and measured in kilograms (kg).

1.5. Assumptions

The study was conducted in light of a few assumptions. First, that participants responded truthfully to the questionnaires. Second, that the children responded to the questionnaires based on a typical day of engagement on the school playground. Lastly, that the children engaged on different locations on the playground.

1.6. Delimitations

This study was delimited to children between the ages of 6 and 9 years. The Playground Engagement Questionnaire (PEQ) was piloted with children 9 -12 years enrolled in the same elementary schools, however they were not part of the study. In addition, this study was delimited by both the operational definitions put in place and to the context and demographic

characteristics of the school, and the children enrolled in that school, as well as the instruments used to measure FMS and PA.

1.7. Limitations

Limitations were present within the study. First, was the possibility that the presence of observers influenced the participants' testing behaviors (Thomas, Nelson, & Silverman, 2011). Second, due to the time of year in which data was collected, weather and season could have influenced the children's PA levels during break periods (Duncan, Hopkins, Schofield, & Duncan, 2008; Ergler, Kearns, & Witten, 2013; Tucker & Gilliland, 2007). Thirdly, the small sample size limits representativeness and thus the generalization of the findings to the general population (Thomas et al., 2011).

Chapter 2: Review of Literature

2.1. Overview

The chapter begins by overviewing children's PA and the current trends and findings related to promoting PA for children. This is then followed by a description and overview of the literature highlighting the importance of motor skill development in children and the relationship between PA and motor skill development. Lastly, the importance of playgrounds as a setting for PA and the current state of research on PA and school playgrounds are described along with the limitations associated with the extant literature.

2.2. Introduction - Physical Activity in Children

Promoting PA during childhood is imperative to ensure children are active during childhood and adolescence; reducing the likelihood of childhood obesity and assisting in children's motor skill development (D'Hondt et al., 2009; Fisher et al., 2005; Goran et al., 1999; Hands, 2008; Trost et al., 2002; Tudor-Locke, Ainsworth, & Popkin, 2001). PA can also have psycho-social benefits such as promoting independence and positive mental health (Haapala et al., 2014; Janssen & Leblanc, 2010; Schoeppe, Duncan, Badland, Oliver, & Browne, 2014). In Canada, it has been recommended that children and youth accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) daily in order to positively improve children's cholesterol, blood pressure, body composition, fitness, and health (Canadian Society For Exercise Physiology, 2014; Tremblay et al., 2011). These recommendations have not been met, with only a third of children and youth meeting the guidelines between 2009 and 2013 (Colley et al., 2011; Roberts et al., 2017). Furthermore, Colley et al. (2011) showed that 62% of children's waking hours were spent sedentary, with sedentary time increasing with age. Only 49.3% of

children achieved the recommended screen-time guidelines (Roberts et al., 2017). In addition other studies have found that declining rates of PA in childhood impact children's health parameters but are also pertinent to both children's motor skill development and future PA (Hands, 2008; Kirchner & Fishburne, 1998; Stodden et al., 2008; Tremblay et al., 2011).

2.3. Relationship between Physical Activity and Motor Skills

Growth and development research states that in early childhood children should be developing their FMS followed by development of their more specialized movement skills as they transition into middle and late childhood (Gallahue & Donnelly, 2003). Specifically, the Gallahue and Donnelly (2003) hourglass model depicts that children from the ages of 2-3 years will begin the initial stages of FMS development and by 5-7 years if children have been provided with the appropriate environment to practice their FMS they should be proficient (Gallahue & Donnelly, 2003). If children have had the opportunity to master their FMS, then during middle childhood they generally begin their transition into more complex specialized skills (Gallahue & Donnelly, 2003; Kirchner & Fishburne, 1998). Children who do not master their FMS may struggle to engage in more complex activities with their peers (Gallahue & Donnelly, 2003; Kirchner & Fishburne, 1998). Thus, the development of FMS has been highlighted as important to ongoing engagement in PA (Fisher et al., 2005; Holfelder & Schott, 2014; Stodden et al., 2008).

There are several studies examining the relationship between motor skills and PA in children. Holfelder and Schott (2014) conducted a systematic review of the studies examining this relationship and found that 12 out of the 23 studies showed a relationship between FMS and PA, nine of which found a positive relationship and three of the studies showed no significant relationship. However, from their analysis there were a few limitations, one of which is that

several of the studies were cross-sectional in design and therefore the same children were not evaluated over time and changes cannot be truly monitored over time (Holfelder & Schott, 2014). Furthermore, they found that the association between FMS and PA was weak likely due to self-reporting of PA (Holfelder & Schott, 2014).

Fisher et al. (2005) studied the relationship between habitual PA and FMS in 394 preschool children. Children were randomly selected, PA was measured with accelerometers and FMS measured with the Movement Assessment Battery for Children (Fisher et al., 2005). The analysis found a weak positive correlations between the overall movement skill score and both total PA and time spent in MVPA, as well as a cross-sectional relationship between habitual PA and FMS (Fisher et al., 2005). Similarly, research conducted by Wrotniak, et al. (2006) supported the presence of a bi-directional relationship between PA and motor competence, as well as other mediating factors. A total of 65 children ages 8-10 years old were measured with accelerometers for PA and with the Bruininks-Oserestsky Test of Motor Proficiency (BOT) for motor proficiency to determine the relationship between motor proficiency and PA (Wrotniak et al., 2006). Results from the data collected found children with less motor proficiency were less physically active, more sedentary, and had a greater body mass index (Wrotniak et al., 2006). Furthermore, there was a significant positive relationship between the scores on the BOT and MVPA ($r = 0.30$; $p = 0.16$). They concluded that children with less motor proficiency had greater standardized BMI, were less physically active, and more sedentary compared to those with higher motor proficiency (Wrotniak et al., 2006). Finally, Larouche, Boyer, Tremblay, and Longmuir (2014), used a motor skill coordination obstacle course as well as pedometers to examine the relationship between motor skill and PA with children aged 9 – 11yrs. Their analysis found that step counts were associated with the motor skill obstacle course times, and

children with higher aerobic fitness and motor skills engaged in more PA (Larouche et al., 2014). Furthermore, balance has been shown to be important for both locomotor and manipulative skills and associated with processing visual information and feedback (Gallahue & Donnelly, 2003; Hatzitaki, Zisi, Kollias, & Kioumourtzoglou, 2002).

A number of researchers have examined the relationship between motor skills and PA longitudinally. For instance, Lopes, Rodrigues, Maia, and Malina (2011) examined 285 children ages 6 – 10 years longitudinally using the Godin-Shepard questionnaire to evaluate PA and the Korperkoordination Test fur Kinder (KTK) test to measure motor coordination over a three year period (Lopes et al., 2011). Over the course of their 3-year evaluation the children's initial motor coordination level impacted their levels of PA. Specifically, children with high initial levels of motor coordination did not have any changes in their PA levels over time, whereas children with low initial motor coordination levels had a steep decline in their PA and those with mid-level motor coordination had slightly less PA decline (Lopes et al., 2011). Barnett, van Beurden, Morgan, Brooks, and Beard (2009) further examined how children's motor skill proficiency was a predictor of adolescent PA in their cross-sectional study. More than 1,000 children were evaluated on eight FMS (catch, overhand throw, kick, forehand strike, sprint, run, leap dodge, and vertical jump) from 18 randomly selected primary schools (Barnett et al., 2009). Approximately six years later half the students were contacted and 29.7% of the half agreed to be evaluated again (Barnett et al., 2009). Using linear regression model, the analysis revealed that object control proficiency in childhood played a significant role in adolescent MVPA levels (Barnett et al., 2009). The childhood object control proficiency of males was also found to play a larger role in adolescent PA compared to females (Barnett et al., 2009). Furthermore, children's

object control proficiency was also shown to impact both their time spent in VPA and their likelihood of participating in organized PA in adolescence.

Similarly, a number of researchers have found support for the influence of children's sex on the relationship between motor skill proficiency and PA (Crane, Temple, Naylor, Gibbons, & Foley, 2016; Farmer, Belton, & O'Brien, 2017; Laukkanen, Pesola, Havu, Sääkslahti, & Finni, 2014). Results varied by PA outcome in some of these studies. For instance, the study by Crane et al. 2016 found that boys' object control skills predicted MVPA levels but their sedentary levels were not related to either object control or locomotor scores; while both girls' MVPA and sedentary behaviors were not related to either their object control or locomotor skills. In contrast to the findings of Crane et al. (2016), Farmer et al. (2017) solely examined female children in one region in Ireland and found that only three of the participants examined had mastered the motor skills evaluated and that those with higher motor skill capabilities had higher PA levels. Laukkanen et al. (2014) found a relationship for both sexes in which 84 boys and girls were examined and girl's gross motor skills were associated with MVPA and boy's motor skills with light, moderate, and vigorous PA.

Beyond sex differences the relationship between motor skills and PA also appears to be affected by children's sport participation. Vandorpe et al. (2012) examined 371 children ages 6-9 years using the KTK to measure motor skills and the Flemish Physical Activity Computerized questionnaire to evaluate PA (Vandorpe et al., 2012). Their analysis revealed that over the course of the three year study, children who participated in a sport club environment displayed better motor coordination than those that did not (Vandorpe et al., 2012). Field and Temple (2017) also explored the relationship between motor skills and PA in relation to sports participation. These authors found that although there was overlap in the type of sport participation, there were

differences between the sexes in terms of the preference for specific activities; with girls participating in more informal PA and boys participating in team sports to a greater degree (Field & Temple, 2017). Between the sexes there were no differences in locomotor scores, but boys had higher object control scores (Field & Temple, 2017). Girls' locomotor scores were significantly and positively correlated with their intensity of participation in gymnastic sports and negatively correlated with water sports (Field & Temple, 2017). Boys' locomotor and object control scores were significantly and positively correlated with their intensity of participation in team sports and their object control scores were negatively correlated with snow sports (Field & Temple, 2017). In order to advance the examination of the relationship between FMS and PA these relationships were further explicated in the PA and Motor Competence Model proposed by Stodden and colleagues (Stodden et al., 2008; Stodden, Gao, Goodway, & Langendorfer, 2014).

2.3.1. A developmental perspective on the role of motor skill competence in physical activity.

Stodden et al. (2008), and Stodden, et al. (2014) developed a conceptual model that proposed that there is a bi-directional relationship between PA and motor skill competence and that this relationship changed as a child moved through early, middle, and late childhood. They also suggested that this relationship was mediated by health-related fitness, individual constraints, environmental constraints, and motor constraints (Stodden et al., 2008). The model reinforces the importance of providing children the opportunity to be physically active in order for them to practice and master FMS (Gallahue & Donnelly, 2003; Hands, 2008; Stodden et al., 2008). If a child is not provided with the opportunity to be physically active they cannot practice and master their FMS; resulting in a potential delay in transitioning to, and development of their complex motor skills (Stodden et al., 2008). In turn, this could result in children self-selecting

into less physically active activities (Stodden et al., 2008). Whereas, those presented with the opportunity to be physically active at a young age and thus practicing their FMS would most likely quickly transition into more complex skills and self-select in to more physically active pursuits (Stodden et al., 2008). Those that were delayed or did not develop the skills would most likely have an unhealthy weight gain throughout childhood (Stodden et al., 2008). Although, there are many factors that influence this relationship, for the purposes of this research the relationship between PA and motor skills will only be explored.

The model presented by Stodden et al. (2008) provides an understanding of the importance of facilitating both PA and motor skill practice. These factors could potentially contribute to or hinder motor skill practice. One of the environmental factors that has been explored in promoting PA for children is the school physical and social environment.

2.4. Schools and Physical Activity

An ecological approach suggests that environmental factors, such as the physical and social environment (i.e. parks, trails, transportation, urban planning, schools) can impact PA and other health behaviors (Bauman et al., 2012). Within the school setting for example everything from policy implementation to the environment itself can influence PA. This perspective has emerged from Bronfenbrenner's ecological model of human behavior (1999) which also highlights the multiple levels of influence: micro (close to the individual e.g. family, friends, physical environment in which children spend their time like the playground or classroom), meso (the organizations and settings surrounding an individual e.g. school, home), and macro (community or state level policy or infrastructure environment, e.g. playground and park provision, walking infrastructure, and school funding policies) (Brofenbrenner, 1999). Brofenbrenner's (1999) ecological model suggests that for an intervention to have an effective

influence, a child must be exposed on a regular basis and for an extended period of time. Recognizing the interaction between children and school within the ecological framework Naylor and McKay (2009) evaluated the current literature on school PA promotion and found that there was stronger success with a whole school setting ecological approach that incorporated policy adjustment and involved youth and families. Haug et al. (2010), also used an ecological approach to understand the variable physical environmental characteristics that influenced children's PA breaks. Their evaluation of over 16,000 students from grades 4 to 10 showed that the different outdoor facilities such as sledding hills and playground equipment influenced the PA participation of both boys and girls (Haug et al., 2010)

With schools being identified as a 'meso' environment (view Figure 1) for PA interventions due to the numbers, age range, diversity (e.g. socio-economic, ethnic and physical and mental abilities) of children that can be reached, and the time spent sedentary in that setting, several interventions have occurred to identify what particular elements or settings within schools are efficacious for promoting PA (Davison & Lawson, 2006; Fairclough, Beighle, Erwin, & Ridgers, 2012; Fox, 2004; Fox et al., 2004; Huberty et al., 2011; Naylor, Macdonald, Reed, & McKay, 2006; Naylor & McKay, 2009; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007).

As time is designated for elementary physical education throughout the school week, interventions in that setting have focused on staff development and training for generalist teachers as one solution to increasing PA (McKenzie, Marshall, Sallis, & Conway, 2000; Sacchetti et al., 2013; Sallis, Mckenzie, & Alcaraz, 1997; van Beurden et al., 2003). Although, the majority were successful in increasing PA, the authors of these studies reported that implementation was challenging due to the resources, such as time and money needed for

teacher/school staff training and the ongoing decrease in time allotted for physical education (Fairclough & Stratton, 2006; Marshall & Hardman, 2000; McKenzie et al., 2001; Zask et al., 2001).

Alternatively, some interventions have promoted PA through classroom based active breaks or active learning within the class and throughout the school day, and were found to be successful in increasing PA (Donnelly et al., 2009; Greene & Dotterweich, 2013; Naylor, Macdonald, Warburton, Reed, & McKay, 2008; Naylor, Macdonald, Reed, et al., 2006; Naylor, Macdonald, Zebedee, Reed, & McKay, 2006; Pangrazi, Beighle, Vehige, & Vack, 2003). These studies also identified barriers of time, competing demands, lack of administrative support, and teacher training (Gibson et al., 2008; Naylor, Macdonald, Reed, et al., 2006; Naylor, Macdonald, Zebedee, et al., 2006) Although, different types of intervention have been successful in increasing PA the effects are modest and common limitations of these approaches include a strong dependence on the teachers to facilitate the PA and barriers like overall school support, other competing demands (i.e. academic priorities), time, the need for resources, training and expertise (Naylor et al., 2015; Russ, Webster, Beets, & Phillips, 2015). Thus, research has also been directed at the school playground and recess where some of these implementation issues may be overcome.

2.4.1. School playground research.

At the micro level of the built environment, school play spaces, specifically playgrounds and the associated recess period during the school day (which occurs on school play spaces) are proposed as a way to promote PA, due to the designated time that children spend each day in recess (approximately 1 hour is scheduled for recess breaks each day), the time children spend in MVPA during recess, and its potential importance as a source of PA for girls (Haug et al., 2010;

Martin, Bremner, Salmon, Rosenberg, & Giles-Corti, 2012; Mota et al., 2005; Ridgers et al., 2010a; Stratton, 2000; Zask et al., 2001). Recess at schools is an important opportunity for PA and the playground where recess occurs an area in which we can continue to promote PA. Research examining school recess periods found that children spend 27.45 minutes of a 60 minutes recess in MVPA and there are minimal differences in MPA between the sexes (Fairclough et al., 2012; Martin et al., 2012). Specifically, Mota et al. (2005) determined boys spent 31% and girls spent 38% of their time in MVPA which accounts for 6.5% and 8.3% respectively of their daily MVPA. Furthermore, children with increased time spent on playground apparatus have shown improvement in upper body muscular endurance (Gabbard, 1983). Within the literature grip strength can be a relative measure of children's general muscle strength (Wind, Takken, Helders, & Engelbert, 2010). Although, the opportunity to promote PA during recess is apparent, there are varying results as to the surfaces and play areas that children engage in the most. In comparing two studies that examined play surfaces Andersen, Klinker, Toftager, Pawlowski, and Schipperijn (2015) found that children spent most of their time on solid surfaces, whereas, Martin et al. (2012) concluded that children engaged more on grass areas. Currently, it can be best be concluded that children's engagement on different play spaces will vary by school (Carlson et al. 2013).

The potential of school playgrounds for promoting PA has led to a variety of playground interventions, which include playground renovations (e.g. Colabianchi, Kinsella, Coulton, & Moore, (2009), adding loose equipment or recyclable material to play spaces (e.g. Engelen et al., 2013), adjusting playground markings and designs (e.g. Blaes et al., 2013), and teacher facilitation (e.g. Brown, Googe, McIver, & Rathel, 2009). Specific details regarding each

respective playground intervention study are shown in Appendix A and an overview is provided following.

2.4.1.1. Playground renovations in promoting physical activity.

Making adjustments to the safety, conditions and cleanliness of playgrounds, and overall renovations have all been tested as ways to increase children's PA on school grounds (Anthamatten et al., 2011; Colabianchi et al., 2009; Colabianchi, Maslow, & Swayampakala, 2011). Using the System for Observing Play and Leisure Activity in Youth (SOPLAY) and examining how PA had been impacted by the quality of a play space the authors of one study concluded that there was increased utilization on renovated playgrounds (higher quality) compared to the playgrounds that had not been renovated (Colabianchi et al., 2009; Mckenzie, 2006). Another study examined playground renovations that increased the diversity of elements (e.g.: banners, gateways, art, and structures) and found an increase in utilization of the elements (Anthamatten et al., 2011). The authors of these studies noted that although there was an increase in the overall utilization it did not increase MVPA, the authors of the studies also noted renovations were not practical due to the cost per renovation (Anthamatten et al., 2011; Colabianchi et al., 2009, 2011).

2.4.1.2. Playgrounds and additional equipment to promote physical activity.

The addition of loose equipment to the playground is another strategy that has been tested (Cardon et al., 2009; Huberty et al., 2011; Ridgers, Fairclough, & Stratton, 2010b). One study using accelerometers and the Observational System for Recording Physical Activity in Children – Preschool version (OSRAC-P), found the addition of loose equipment decreased sedentary activity ($p < .001$) and increased light ($p < .001$), moderate ($p < .001$), and vigorous ($p < .001$) PA in both male and female children enrolled in the study (Hannon & Brown, 2008). A second

study, which added specific types of loose equipment to the playground, determined through coded observation that added equipment enabled children to construct and develop their own play areas and promoted different types of play; however they did not measure PA levels and intensity (Maxwell, Mitchell, & Evans, 2013). Furthermore, both studies determined that different types of equipment allowed children to engage in different motor skills that matched their motor development level (Hannon & Brown, 2008; Maxwell et al., 2013). Although these studies found changes in behavior of the children, both of these studies focused on the preschool age group.

2.4.1.3. Playgrounds and recyclable material.

Using recyclable material (i.e. Styrofoam boxes, milk crates, and car tires) has been another way in which PA has been facilitated on the playground. Unlike loose equipment the recyclable material used in these studies have no obvious 'active play value' or in other words the material was not sport or PA equipment – it included things like cardboard boxes, different fabrics, tires and logs (Bundy et al., 2011; Engelen et al., 2013). A three-year cluster randomised control trial for children ages 5-7 years resulted in a small significant increase in MVPA minutes ($\overline{X}$=1.8 minutes, p = 0.006), decreased sedentary activity ($\overline{X}$=2.1 minutes, p = 0.01) and overall 12% more MVPA for the intervention group during break times (Engelen et al., 2013). An examination of PA two years post-intervention in a group of 16 of the intervention children showed that a mean increase in MVPA of 1.7 minutes, although a moderate effect (p=0.07, d=0.48), was not statistically significant possibly due to the small sample evaluated two years later (Engelen et al., 2013). The use of recyclable material although having no obvious 'active play value' provided unstructured multi-purpose PA opportunities. Although this provided a

novel and cost-efficient method in promoting PA, effects were modest and they appeared to degrade over time. Replication studies with short and long-term measurement are needed.

2.4.1.4. Playgrounds aesthetics and markings.

The impact of playground aesthetics and markings have been the most frequently examined playground intervention. This intervention includes markings and aesthetics added to the school playground such as: imaginative pictures, coloured zones, and coloured features (Blaes et al., 2013; Cardon et al., 2009; Huberty et al., 2011; Loucaides, Jago, & Charalambous, 2009; Ridgers et al., 2010a; Ridgers, Stratton, Fairclough, & Twisk, 2007; Stratton, 2000; Stratton & Mullan, 2005). Studies using this type of intervention have examined the impact on children from preschool to grade seven and used both direct observation and accelerometry. Analysis revealed that playground markings resulted in a significant increase in the time spent in specific PA levels, as well as decreased sedentary time (Blaes et al., 2013; Huberty et al., 2011; Loucaides et al., 2009; Ridgers et al., 2010a, 2010b, 2007; Stratton, 2000; Stratton & Mullan, 2005). Specifically, two playground marking studies found significant difference in MVPA and VPA six months post intervention, suggesting the potential to sustain PA beyond the novelty period (Ridgers et al., 2010a, 2007). Although, playground aesthetics and marking interventions are shown to facilitate PA, and one study shows sustained impact at six months, further investigations are needed to solidify whether these changes are sustainable or, similar to other playground renovations are simply due to the novelty effect.

2.4.1.5. Playgrounds and play facilitation.

Teacher-based facilitated PA has also been used to increase PA on the school playground (Brown et al., 2009; Sallis et al., 2003) but the number of studies are limited and one was implemented with preschool children and the other in middle school. Brown et al. (2009)

assessed two teacher-based interventions in a small sample of preschool children. The first intervention involved a teacher leading and engaging in a dance around the playground for a small group of preschoolers, and the second intervention focused on targeting specific individual sedentary low-income children using the same protocols (Brown et al., 2009). Using the OSRAC-P the interventions resulted in significant increase in PA intensity (Brown et al., 2009). The first intervention was able to increase MVPA on intervention days compared to non-intervention days, while the second intervention was able to replicate the findings of the first intervention (Brown et al., 2009). Using an ecological approach Sallis et al. (2003) conducted the Middle School Physical Activity and Nutrition study (MSPAN) which focused on both healthy eating and physical activity targets across multiple micro-environments. In addition to addressing PA in physical education it including promoting PA throughout the day (before and after school and in the post-lunch break) and using volunteer PA providers on the playground (Sallis et al., 2003). The MSPAN intervention (including both PE and playground PA interventions) had an effect on the PA of the total group and boys, but not girls (Sallis et al., 2003). Further examination of PA by sex revealed that boys PA increased both during physical education and outside of physical education, whereas girls PA only increased during physical education (Sallis et al., 2003). Although, these findings represent the impact of a multi-layered approach addressing more than one setting, they do highlight the potential benefit of playground facilitation and different responses associated with an individual level factor, sex.

2.5. Limitations of Current Playground Research

It is clear from the review of interventions on the school playground that they have produced positive increases in children's PA. However, there are several limitations associated with the interventions to date. In particular, the modifications to playground designs lacked

specific description to allow for replication and these studies provided little information about how the varying designs on the school grounds enabled different types of engagement and PA intensity levels (Anthamatten et al., 2014; Hart & Sheehan, 1986; Maxwell et al., 2013).

There was also a lack of consistency in the instruments used to measure PA time and intensity (Loucaides et al., 2009; Ridgers et al., 2010b; Zask et al., 2001). Studies relied on direct observations or accelerometers, however there were inconsistencies in the observational methods used and the cut points for accelerometers (Mackintosh, Fairclough, Stratton, & Ridgers, 2012) A lack of consistency makes it difficult to compare and understand the success of each intervention. Furthermore, the studies reviewed only examined the impact of an intervention, and did not continue to explore how children's current ability levels and other individual factors like enjoyment may influence their engagement.

Lastly, the studies were limited in their examination beyond PA intensity on the playground. With playgrounds having varying features and locations, the extant literature research fails to acknowledge children's utilization and PA intensity in the different locations on the school ground (Anthamatten et al., 2014). The interventions did not describe the types of activities that children were typically engaged in, where they were active, or their level of activity in those spaces. From the current playground literature there is support for the efficacy of playground interventions and that they quantitatively increase PA time and intensity during school break periods. However, there is a lack of information about the utilization of varying areas on the school grounds within the quantitative studies conducted. This information could have been supplemented with more qualitative descriptions of the types of activities children were participating in, which may influence both their motor skills and activity intensity. Furthermore, past research has noted that there are overall differences in PA between the sexes,

and that a large majority of children have not achieved mastery of their FMS. Playground interventions, although successful in increasing the time and intensity spent in PA, have not yet been examined in terms of how they serve children of different sex, PA levels, and FMS mastery. Thus, these interventions could simply be increasing the level of PA of children that are already active.

2.6. Playground Design

Although varying features have been modified on the school playground in an attempt to increase PA there is limited analysis on the specific impact of the overall playground design on children's PA intensity and types of usage. Playground designs can be categorized as traditional, contemporary, and adventure (Barbour, 1999; Hart, 1992; Holmes & Procaccino, 2009). Traditional playgrounds are composed of large metal equipment, fixed structures, large areas and are more fitness and exercise oriented (Barbour, 1999; Hart & Sheehan, 1986; Holmes & Procaccino, 2009; Maxwell et al., 2013; Pellegrini, 1987; Rothenberg, Hayward, & Beasley, 1974). These types of playgrounds are the most commonly found in parks and school grounds and the type of behavior children engage in is based on the type of equipment that is there (Maxwell et al., 2013; Sanderson, 2011). Contemporary playgrounds emphasize textures, foster dramatic play, and may have a natural play scape (Barbour, 1999; Hart & Sheehan, 1986; Holmes & Procaccino, 2009; Maxwell et al., 2013; Pellegrini, 1987; Rothenberg et al., 1974). Contemporary types of playgrounds are suggested to promote less PA and focus on aesthetic features that are catered to the elements available on the play space (Rothenberg et al., 1974; Sanderson, 2011). Adventure playgrounds often have moveable materials (e.g. logs and stumps) in which children are able to develop their own play areas and provide opportunities for risk (Barbour, 1999; Hart & Sheehan, 1986; Holmes & Procaccino, 2009; Maxwell et al., 2013;

Pellegrini, 1987; Rothenberg et al., 1974). Adventure playgrounds are less structured compared to the traditional and contemporary playground designs and promote constructive play (Barbour, 1999; Rothenberg et al., 1974). Despite the described benefits of each type of playground, it appears that few studies have examined what playground design features are being used in different parks and play areas. Olsen and Smith (2017) recognized the importance of play space features for children's PA and evaluated the features available in the child care environments in one state in the USA (Olsen & Smith, 2017). The researchers used a playground program inspection handbook and a handbook for playground public safety to audit play spaces at a variety of randomly selected facilities in one state (Olsen & Smith, 2017). From their audit they determined that over half of the play spaces were developed from the year 2011 onwards and included grass areas, areas to practice gross motor skills, and open areas (Olsen & Smith, 2017). Further, their observations revealed that 83% of the playgrounds audited had appropriate falling surfaces, and 90% had loose equipment available for children to engage with (Olsen & Smith, 2017). It was also noted that one quarter of the play spaces audited had playground designs that offered play opportunities appropriate for older children (not appropriate for younger children) and only 43% of loose equipment was considered to be in a good condition (Olsen & Smith, 2017). Lim, Donovan, Harper, and Naylor (2017) continued this exploration on playground design by examining the natural elements on school playgrounds, which was previously unexamined. The researchers examined 99 elementary schools across five school districts in which socioeconomic status varied (Lim et al., 2017). Using predefined operational definitions, and a reliable checklist was used to categorize each nature element on the playground. FMS opportunities potentially associated with each nature element were predetermined through negotiated consensus among the researchers (Lim et al., 2017). The analysis revealed that

although the frequency of nature elements was low and varied, there were nature elements that were accessible across the school districts and that they afforded mostly stability and locomotor opportunities (Lim et al., 2017). Although, the types of playground designs have been described and identified, there is limited research exploring the association between the specific type of playground design (i.e. traditional, contemporary, adventure) and children's motor skill and PA behavior.

2.6.1. The impact of playground design on children's motor skills.

Evidence suggests the playground design can influence children's engagement, physical competence, choice of activities, and their physical skill development (Barbour, 1999; Brown & Burger, 1984). Barbour (1999) explored the impact playground design had on the physical competence on eight children at two different schools. Using the BOT children's motor skills were scored and eight children (4 at each school) were observed for ten 30-minute recess periods using scans ranging from 2-5-minute intervals (Barbour, 1999). Scans were used to create a descriptive narrative and field notes (Barbour, 1999). Following the scans, semi-structured interviews were conducted with the children to gather further information about their activities during recess, as well as their social and physical involvement (Barbour, 1999). Analysis of the data collected revealed that playground design influenced children with both high and low motor proficiency. Observations showed that playgrounds with more equipment/infrastructure features variety, such as different types of swings (tire swing, conventional swings), seesaw, sandbox, and areas to engage in dramatic play (i.e. pretending to play house), provided opportunities for children of low motor competence to engage in active play (Barbour, 1999). The conclusion from the research was that regardless of the playground design the equipment and features needed to provide a level of challenge suitable for children

across the spectrum of motor skill proficiency (Barbour, 1999). The study concluded that there was an inherent relationship between the child's motor proficiency and the overall design. Specifically, a playground with more traditional and fixed structures limited the participation of the children with low motor proficiency, whereas the playground design with more features and options provided children with low motor proficiencies opportunities to participate (Barbour, 1999).

Although, there is limited additional evidence of the relationship between playground design and children's motor behaviors Brown and Burger (1984) were able to evaluate children's behavior on a contemporary playground design. Their study examined a total of 72 children at six playgrounds (12 children were observed at each playground site) by observation (Brown & Burger, 1984). The contemporary playgrounds in which the children were engaging in play were divided into two categories based on the number of structures and opportunities for play. Playgrounds were rated based on a 19-item scale which examined four component areas: social/affective, cognitive, motor, and practical. Elements of the scale were decided based on the literature and resulted in playgrounds being considered higher rated playgrounds or lower rated playgrounds (Brown & Burger, 1984). Their results revealed no overall differences in motor behaviors between playground quality categories (high versus low), but did show a sex-based difference with males engaging in more locomotor activities and females engaging in more balance activities (Brown & Burger, 1984). Brown and Burger suggested that the lack of difference in motor behavior on different playgrounds was due to the aesthetics of the playground items and the type of equipment available at the different playgrounds. These results provide some insight into the potential sex-based differences in motor behavior with specific

playground designs. However, without knowing children's motor proficiency and with such a small sample size the relationship between motor behavior and playground design is still unclear.

Sex-based differences in play have continued to be explored in the context of playground design. A study by Harten, Olds, and Dollman (2008) examined the relationship among sex, play area, PA intensity, and motor skills in children 8-11yrs old using two related studies (Harten et al., 2008). The first study examined PA and a battery of motor skills (standing long jump, ball catch, 20m sprint, and agility run) among grade 3 and 4 children. From their motor skills scores, children were grouped as high or low motor skilled and were then evaluated on how they engaged in different sized play areas. Harten et al. (2008) reported on the same study but examined children in grade 5 only at one school using the same motor skill battery of tests. Children were then observed using SOPLAY examining how they engaged in three different size play spaces (small, medium, large). From the first study that examined children in grade 3 and 4, boys with higher motor skills were found to be more active than those with lower motor skills and boys engaged in more PA in larger play spaces. Unlike the boys, girls with higher motor skills were not significantly more active than lower motor skilled girls and were not more active in larger play spaces. Similar to the findings for grades 3 and 4, grade 5 boys with higher skill levels in the second study were more active and more intensely active on the larger play space, while the grade 5 girls' PA did not vary based on motor skills. However, unlike the study of grade 3 and 4 children, grade 5 girls' PA intensity differed significantly from the large space compared to the small space (Harten et al., 2008). Thus, girls' motor skills did not predict PA on the playground while boys did and there was some indication that the play space influenced PA intensity for both older boys and girls.

2.6.2. The impact of playground design on children's strength.

Another area of playground research related to PA addressed children's strength although to the best of my knowledge there was only one study by Gabbard (1983) who examined how children's strength related to playground design. As Barbour (1999) had previously mentioned it was important to have a variety of equipment and apparatus for children of both low and high motor proficiency to engage and practice their motor skills, however the study did not mention how playground equipment could also be an important contributor to children's strength. Gabbard (1983) conducted a study of 90 children split between an intervention and control group and examined how muscular endurance changed in the intervention group where children were given access to playground equipment such as overhead ladders. Results from their study revealed that those in the intervention group had an increase in upper body muscular endurance which was measured by a straight arm hang (Gabbard, 1983). Further studies have yet to examine the association between muscular strength and endurance and playground design, however this study by Gabbard (1983) provides insight into the potential impact that playground design could have on children's muscle development which could contribute to playground engagement. Replication of this study and further examination of the relationship between playground design and muscular strength is needed.

2.6.3. The impact of playground design on children's physical activity.

Several researchers have examined the relationship between playground design and children's PA. A systematic review by Escalante, García-Hermoso, Backx, and Saavedra (2013) examined eight intervention based studies that focused on increasing PA during recess by manipulating elements of the playground. From their review they were able to conclude that newer markings or built structures modifications provided an overall increase to PA over the

short (approximately 6 weeks) and medium term (approximately 24 weeks) (Ridgers et al., 2007). Furthermore, a study by Cotton, Dudley, Jackson, Winslade, and Atkin (2017) went beyond measuring the association between playground design and PA, and aimed to explore how this opportunity to be active on the playground would then impact children's behavior. Specifically, they proposed modifying environmental factors, such as playground design, along with providing teacher training and resources and then studying how this would impact children's PA intensity and support their social and emotional well-being. Although, there were some limitations regarding the number of observations during baseline data collection, the researchers found a significant decrease in sedentary activities ($p < 0.05$) and a significant increase in VPA ($p < 0.001$) (Dudley, Cotton, Peralta, & Winslade, 2018). There were also changes in VPA based on play surface and activity type. The intervention resulted in a significant increase of VPA on both hard and soft surfaces, as well as an increase in VPA by boys and girls while playing soccer (Dudley et al., 2018). Similarly, Anthamatten et al. (2014), examined children's usage and PA in different playground zones in two types of playground designs. Their study compared three schools that had undergone a Learning Landscape playground design change compared to three schools that were not provided with this playground design renovation (Anthamatten et al., 2014). Data was collected at baseline and post renovation over the period of approximately one year in which children's PA and usage was observed for four consecutive days (Anthamatten et al., 2014). From the observations there were both general differences in utilization and PA intensity throughout the different areas, as well as sex-based differences (Anthamatten et al., 2014). Overall, utilization was found to be higher in the swings, hard surface, and play equipment areas (Anthamatten et al., 2014). Rate of moderate to vigorous PA was found to be higher in all areas with playground equipment (i.e. swings, play

equipment, basketball, and tetherball areas) (Anthamatten et al., 2014). The playground design opportunities also highlighted sex-based differences, where boys used the field and basketball areas more, with higher rates of PA intensity in the field, hard surface, and play equipment areas and girls utilized the play equipment areas more (Anthamatten et al., 2014). Although, there were variation in where children engaged by sex the actual activities children engaged in was not evaluated.

The playground design and PA relationship has also been examined with younger children. Berg (2015) examined four preschools in British Columbia using a modified version of SOPLAY and found that children spent a lot of time sedentary in different playground designs. Interestingly, the playground design which had the highest rate of VPA was a playground that had minimal fixed structures, more moveable pieces, and a large open grassy area (Berg, 2015). Further factors also taken into consideration beyond playground design was the accessibility to equipment and play space features and teacher student engagement ratio (Berg, 2015). Berg's evaluation of PA across different playground designs also found that the increased loose equipment was associated with higher levels of VPA and that caregivers and supervisors provided a positive role model to promote PA. This study, however did not provide insight into differences in usage of play spaces by sex, and mentioned that children needed opportunities for developmental play without describing what type of play children engaged in on the most active playground design space.

2.7. Limitations of the Literature in Relation to this Study

The existing playground literature has focused on ways to promote PA, but researchers are just beginning to explore the association with motor skills and there remains several limitations to the literature. First, there is a failure to consider the impact of the weather on

outdoor PA on school playgrounds. Considering the time spent outside during break periods, understanding the impact of weather is important (Tucker & Gilliland, 2007). As an example, cold weather and rain were found to decrease children's time and level of PA (Duncan et al., 2008). In contrast, a 10 degree Celsius increase in mean ambient temperature from the winter season (range 8 – 13 degrees Celsius) to the summer season (range 17 – 23 degrees) was associated with an increase in weekday steps for children (Duncan et al., 2008; Goodman, Panter, Sharp, & Ogilvie, 2013; Tucker & Gilliland, 2007). Additionally, teachers are in control of the decision to have break period inside or outside and if teachers perceive the weather to be poor there is an increased likelihood of children being kept indoors (Copeland, Kendeigh, Saelens, Kalkwarf, & Sherman, 2012; Duncan et al., 2008; Goodman et al., 2013).

More importantly, the current literature has limited consideration of where children engaged on the school grounds and how their motor competence, current PA levels, and other individual factors related to their playground play choices. Briefly highlighted in the study by Barbour (1999) children's motor skills influenced their playground engagement and the motor skills they were able to practice. With children moving through their growth and development path an understanding of where and how (intensity and enjoyment) children of high and low motor competence engage on the school grounds as well as the motor skills practiced could assist in providing the appropriate interventions (Gallahue & Donnelly, 2003; Kirchner & Fishburne, 1998; Payne & Isaacs, 2005).

The decreased rates of PA in children have led an exploration in how we can facilitate increased PA (time and intensity) in children (Colley et al., 2011). The continued children's PA promotion has been both for children's current physical and psycho-social health, but also their future PA participation, and health as an adult. From the research that has been conducted we

have an understanding of the relationship between children's motor skills and PA and how they influence each other (Fisher et al., 2005; Robinson et al., 2015; Stodden, True, Langendorfer, & Gao, 2013). Furthermore, in using the ecological model school playgrounds can be identified as an area in which PA can be encouraged due to the amount of time spent there (Bauman et al., 2012; Brofenbrenner, 1999; Haug et al., 2010; Martin et al., 2012; Mota et al., 2005). From the existing playground literature researchers have identified that there are varying types of playgrounds with different features, and that access to loose equipment and renovations can facilitate increased PA time and intensity over a short to medium time period (Escalante et al., 2013; Maxwell et al., 2013). The size of play space, density within the play space, and types of equipment and structures influence the engagement level of children of different motor capabilities (Haese, Dyck, Bourdeaudhuij, & Cardon, 2013; Harten et al., 2008; Nielsen, Bugge, Hermansen, Svensson, & Andersen, 2012). However, researchers have not extensively examined the influence of individual level factors on playground engagement and behavior. Specifically, more information is needed about how children of varying motor skill levels engage in different play spaces on the school playground (frequency, intensity, enjoyment), and how children's PA participation outside of school, children's strength, and sex could influence their PA and playground behavior.

Chapter 3: Method

3.1. Overview

This chapter will outline the research design, participant recruitment, instrumentation, data collection, and data analyses conducted during the study. The steps used to pilot the playground engagement and enjoyment questionnaire used in this study are also described.

3.2. Research Design

A mixed method research design was used to describe and explore the relationships among FMS (including balance), grip strength, PA (overall and recreational), and playground usage and enjoyment and compare these variables between children of high and low FMS and between sex.

3.3. Ethics

Ethics approval for this study was obtained through the University of Victoria Human Research Ethics Board (ethics certificate #14-444) (Appendix B) and permission from School District 63 (SD 63) was also obtained (Appendix C).

3.4. Recruitment and Sampling

Participants were recruited from one elementary school in the Saanich School District (SD 63). The neighbourhood school district in which the school is located is categorized by statistics Canada as having a small population, and having a vulnerability score of 16% on one or more of the categories measured by the Early Development Index (wave 6 evaluated from 2014-2016). In comparison to local surrounding neighbourhoods this vulnerability is quite low and has had a critical decrease in vulnerability since the previous evaluation (wave 5 evaluated from

2012-2013) in which vulnerability of the area was at 29% in one or more categories evaluated. The Early Development Index measures five areas (physical health and well-being, language and cognitive development, social competence, emotional maturity, and communication skills and general knowledge) that are key predictors for a child's development to adult health, education, and outcomes (The Human Early Learning Partnership, n.d.). This school was selected based on their willingness to participate. The Principal asked all grade two and three teachers at the school about their willingness to participate in the study and all three teachers volunteered to have the research team attend their class and collect data. The elementary school itself contained multiple large play spaces, including multiple court areas, a large field space, and multiple built structure areas in which children could engage. Consent forms were distributed to all 66 children in these classes by their teacher. Fifty-five parents/guardians provided consent for their child to participate and 54 students completed all measurement components. This represents an 83% consent rate, and of those consented, a 98% completion rate. Consents forms can be viewed in Appendix D and the letter of information in Appendix E.

3.5. Instruments

3.5.1. Participant information.

Parents/guardians provided participant demographic information (sex, age, disability status) via a brief survey included in the consent materials (see Appendix D). Consented students were assigned a code to identify them confidentially during the motor skill testing, as well as for data entry, storage and analysis.

3.5.2. Motor skills-Test of gross motor development second edition (TGMD-2).

Children's motor skills were assessed using the Test of Gross Motor Development Second Edition (TGMD-2) (Ulrich, 2000). The test consists of six locomotor skill and six object control skill assessments (Ulrich, 2000). Specifically, the locomotor sub-test evaluates a child's run, hop, gallop, leap, horizontal jump, and slide and the object control sub-test evaluates a child's striking, dribbling, catching, kicking, overhand throwing, and underhand rolling (Ulrich, 2000). A student was given two trials with each skill and was evaluated on three to five performance criteria for each skill (Ulrich, 2000). For each performance criteria a child was given a score of 1 for the criteria being met or 0 when the criteria are not met (Ulrich, 2000). A score total out of 48 was then provided for both the locomotor and object control sub-tests, and a combined score ranging from 0 – 96 (Ulrich, 2000). The resulting total raw score was then converted into normative percentile ranks and a gross motor quotient (Ulrich, 2000). In order for the lead researcher to score the skills, the children that consented were video recorded to be scored post data collection. All children in each class participated in the TGMD-2 testing, but only those children that consented were video recorded (for subsequent analysis and scoring) and all non-consented children were grouped together and participated without being recorded as per existing protocols (Crane et al., 2015; Field & Temple, 2017).

The TGMD-2 test is a validated, criterion-referenced, norm-referenced, and a process-oriented assessment (Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014). The test has established content-validity, criterion-related validity, and construct validity (Ulrich, 2000). Furthermore, the TGMD-2 has adequate test re-test reliability (Ulrich, 2000). The TGMD-2 has been used to assess children's general FMS, how FMS are impacted by health-related issues and the relationship between FMS and PA (Crane et al., 2016; Niemeijer, Smits-Engelsman, &

Schoemaker, 2007; Niemeijer, Schoemaker, & Smits-Engelsman, 2006; Okely et al., 2001; Siahkouhian, Mahmoodi, & Salehi, 2011; Temple, Crane, Brown, Williams, & Bell, 2016; Zask et al., 2012).

3.5.3. Motor skills - Stork stand balance test.

Children's static balance was evaluated using the stork stand test, as balance impacts both locomotor and object control skills (Gallahue & Donnelly, 2003). The stork stand balance test is shown to have moderate to high inter-rater and test-retest reliability (Atwater, Crowe, Deitz, & Richardson, 1990).

To perform the stork stand balance test the child stood on one foot with the sole of the other foot placed on the side of the knee of the weight bearing foot, hands placed on their hips with fingers forward (Temple et al., 2016). Children performed the stork stand two times on both the dominant and non-dominant leg and attempted to hold the position for a maximum of 30 seconds. Time was stopped if the child moved the weight bearing foot or if the non-weight bearing foot touched the ground or was used to support the weight bearing foot (Temple et al., 2016). Full details of the exact verbatim instructions given to the research assistants on how to perform the stork stand balance test with the child can be viewed in Appendix F.

3.5.4. Strength.

The hand grip strength test and protocol from the Canadian Society for Exercise Physiology was used to assess strength in this study (Canadian Society For Exercise Physiology, 2015). The handheld dynamometer that was used was the SMEDLEY III hand grip dynamometer (Model 68812). The dynamometer was placed between the fingers and palm and the grip aligned with the second joint of the fingers. Once aligned the child held the dynamometer in line with the

forearm slightly away from their thigh. The child exhaled and squeezed the dynamometer. The child performed this with each hand twice and alternated between hands (Canadian Society For Exercise Physiology, 2015). Further details on the exact instructions that were given to the research assistants can be viewed in Appendix G.

3.5.5. Physical activity.

To evaluate children's PA and use of the playground, a playground enjoyment questionnaire (PEQ) was created incorporating a set of questions from the Physical Activity Questionnaire for Children (PAQ-C) as a measure of overall PA. (Kowalski, Crocker, & Donen, 2004). Specifically, the first six questions for the Playground Enjoyment Questionnaire (PEQ) addressed PA and were derived from the PAQ-C, which has established reliability and validity and found to be stable for both sexes (Kowalski et al., 2004). Questions 2-6 from the PAQ-C were used to assess children's general PA over the past seven days in different time periods including physical education class, recess, lunch, right after school, evenings, and the previous weekend (Kowalski et al., 2004). All answers that children could provide were on a 5-point Likert scale.

3.5.6. Playground use and behavior.

The PEQ was also designed to ask where children liked to play on the school grounds (location and frequency, favourite and least favourite areas), what activities they liked and reported participating in when playing during the various break periods (type and intensity). Beyond the PAQ-C questions the questionnaire included short answer questions (the areas they enjoyed, did not enjoy, the specific activities they did during their break, and whom they were with) and Likert scale questions on their frequency, intensity, and enjoyment of each play area. It

also included a coded map of the children's playground and photo images of each coded area to make it easy for children to identify where they played when answering the questions. To review the specific questions in the PEQ and the playground areas please see Appendix H. Prior to being used, the last question of the PEQ (i.e. question 10) was pilot tested and repeat reliability evaluated with a group of Grade 4-5 students (*n*=16 out of 25 children in a classroom) from the same school (i.e. 71.43%). The pilot test involved a two-step process, the first of which was the creation of the questions, the second being having the children go through the question to determine the clarity of the questions. From the pilot test, and test retest for stability only minor grammatical changes were made for clarification. Test re-test stability was conducted over the course of one school day in which children were asked the questions in the morning and then asked the same questions in the afternoon, post-lunch recess. The lead researcher assessed the test re-test stability by calculating percent agreement (the agree/disagree method). Children's responses that were the same in the morning and afternoon received a "1" for agreement and if they did not, they received a "0" for disagreement. Children's responses were grouped based on play space types rather than individual play spaces. Play spaces that were shown in the PEQ were all categorized into different zones, categorizations were determined from SOPLAY, in which play spaces are defined as target areas where children can be physically active (Mckenzie, 2006). From the play spaces observed at the school five play space types were identified: field, built structures, courts, tarmac spaces, and nature spaces. Field spaces were identified as the open green spaces, such as soccer/football fields that were man-made and maintained. Built structure areas were identified as the man-made structures that were fixed including playgrounds and swings. Court areas were identified as areas in which net sports were located on a hard surface, such as basketball courts. Tarmac spaces were identified as hard surfaces in which there are

markings or no markings on the ground, such as four-square, tetherball areas, and hop scotch. Nature space areas were identified as areas which were composed of all nature elements with limited to no man-made structures. A legend of the zones that were categorized into the five play spaces can be viewed in Appendix I.

The questionnaire was set up so they were asked the PAQ-C questions first followed by the remaining questions. For the PAQ-C segment in the questionnaire the research assistant explained to the child that they should answer what they felt best represented them over the past seven days (Kowalski et al., 2004). For the remaining questions on the questionnaire children were provided with several images of their playground. The first image presented to them was an aerial view of their playground in which the playground had been colour coded and numbered into 14 different sections to represent the different areas of the school play space that researchers identified as distinct. Additional images were provided to the children that showed the specific coloured coded and numbered play spaces. For these questions, children were asked about their favourite and least favourite play spaces, where they liked to engage, what activities they liked participating in how often they played in the varying play spaces, and who they played with in those areas.

3.5.7. Recreational Physical Activity.

The Children's Assessment of Participation and Enjoyment (CAPE) was used to assess after school participation in physically active recreation. The test has been used with children and youth ages 6 to 21 years both with and without a disability (King et al., 2007). The questionnaire has 55 questions which evaluate five dimensions of children's participation and three different level of scoring: overall participation, participation in formal and informal activities, and participation in five different types of activities (King et al., 2007). The five

different types of activities that are measured through this questionnaire are: recreational, active physical, social, skill-based, and self-improvement activities (King et al., 2007). For the purposes of this study only the questions about the frequency of active physical pursuits (i.e. diversity) were of interest. This sub-scale has 13 questions. The CAPE questionnaire has been tested previously for both validity and its reliability (Imms, 2008). In using the CAPE questionnaire children are first asked if the child participated in the activity. Additional questions would be asked if they responded to "yes" however if the child did not participate in the questioned activity the research assistant would move on to the next question. The research assistant proceeded to ask each question in the following protocol: they asked the child if they participated in the activity presented in the book, if the child said "no" the research assistant would move on to the next question. However, if they said "yes" the research assistant would then continue and ask questions related to the child's frequency of participation in the past 4 months, whom they participate with, where they participate and how much they enjoyed participating in the activity. Further details on the CAPE questionnaire and scoring can be viewed in Appendix J.

3.6. Procedures

3.6.1. Training of research assistants.

Research assistants (n = 8) were trained in the administration of the TGMD-2 and CAPE Questionnaire by the project coordinators. The TGMD-2 training involved a theoretical overview of the components of each skill, how to evaluate each skill, and how to administer the test. Additionally, the training involved practicing administering the protocol and practicing scoring live. Research assistants also trained to administer the PEQ by the lead researcher. This training involved becoming familiar with the questions and how to ask the questions.

After University Human Research Ethics, School Board, Principal and teacher approval, consent forms were distributed by the researcher to the designated classes. Each participant that consented completed the battery of tests and/or questionnaires. All of the testing schedules were organized collaboratively by the lead researcher and the project coordinator and performed over the period of a month.

The majority of the data collection occurred over four days during a two-week period. Additional follow-up sessions were added as some students were unavailable during their designated testing period. Motor skills were assessed during two physical education lessons. Each physical education lesson was approximately 30 minutes in duration. In preparation for motor skills assessments, each class was divided into four small groups. Upon entering the gym, the four groups would go to four separate stations where they would complete two or three TGMD-2 skills designated for that station. Each group would complete two of the four TGMD-2 stations per physical education class. All testing stations and groups were prepared and kept the same over the two physical education classes. Arrangements were made to test any children that were unavailable during the testing dates. Assessment occurred with one of the other classes participating in the study or when the gym was available.

The CAPE and the PEQ questionnaires were administered during children's class time. During the two weeks in which motor skill testing occurred the teachers and the lead researcher scheduled an appropriate time in which children would be able to leave the classroom and complete the questionnaires. Children only completed the questionnaires during their quiet self-paced task completion periods (e.g. silent ready/worksheet completion versus active lesson delivery) with the addition of a research assistant facilitating the questionnaire, and these were completed in two phases to accommodate children's attention spans and the typical length of

study periods. During the first phase of questionnaires children completed the CAPE and during the second the PEQ. For both questionnaires' children were interviewed individually by a researcher assistant. Prior to administering each questionnaire children were provided with an explanation of the questionnaire. For each questionnaire children were provided all the materials necessary (e.g. visual booklet) and all responses were recorded on respective scoring sheets All scoring sheets listed the date and the child's code to ensure confidentiality.

CAPE administration was completed using the designated scoring sheet, as well as the visual booklet. The test took approximately 30 minutes to complete, depending on the number of activities the child participated in and the test was also done at the child's pace. The research assistant would read the questions to the child while showing the visual images for the questions and the child would respond accordingly. The PEQ was completed on a subsequent research day from the other questionnaires. This questionnaire took approximately 20 minutes and like the other questionnaires was led by a trained researcher assistant.

Grip strength and stork stand were assessed after the completion of the TGMD-2 or questionnaire sessions. Specifically, if the TGMD-2 testing was completed early and while waiting for the remainder children to complete their tasks, research assistants were instructed to first complete the stork stand test and record the results on the master sheet. As there was only one handheld dynamometer the grip strength test was done after children had completed or waited to complete their stork stand or after completing one of the questionnaires.

3.7. Data Analysis

All data and child codes were stored at the University of Victoria in a locked cabinet in a secured research laboratory (paper copies) and on a password protected dedicated research Local Area Network (electronic data files) on the University of Victoria Faculty of Education research server.

Data was analyzed using SPSS statistical software version 20, along with Microsoft Excel 2013. Statistical significance was set a priori at an alpha of 0.05. Data analysis differed depending on the measure.

3.7.1. Data treatment.

Data collected via each instrument was transformed to conduct the analysis necessary for this study. All raw data was first entered and then converted.

3.7.1.1. Motor skills – Test of gross motor development second edition.

For FMS, both TGMD-2 raw scores and sub-scale standard scores (locomotor and manipulative) were calculated, as well as the gross motor quotient which was compared to the gross motor quotient scoring chart (Ulrich, 2000). Raw scores in the TGMD-2 test refer to the child score based on the performance criteria for each skill evaluated, while sub-test standard scores convert the skill performance score based on a distribution curve, which allows children's scores to be compared and evaluated (Ulrich, 2000). Locomotor and object control scores for each child was totaled and along with their age were used to determine their standard score by comparing it to a TGMD-2 conversion chart (Ulrich, 2000). Once the standard score for both object control and locomotor were determined they were summed and the total of the locomotor and object control standard score were compared to the TGMD-2 gross motor quotient

conversion table (Ulrich, 2000). Gross motor quotient scores are considered another type of standard score which is converted to a quotient with a mean of 100 and standard deviation of 15 (Ulrich, 2000). Due to the small sample size the average gross motor quotient score was calculated from the sample (M = 63.00, SD = 2.46). All children's scores that fell below the mean were considered to have lower motor skills and those that were above were considered children with higher motor skills.

3.7.1.2. Motor skills – Stork stand balance test.

For balance, two stork stand scores for each leg were added together and averaged to get a balanced time score for each leg. If a child achieved the maximum time of 30 seconds on their initial trial, they were not required to complete the second trial for that leg. Average scores for both legs were averaged to give a unified balance time for analysis.

3.7.1.3. Strength.

Grip strength scores for both hands were added together and averaged to calculate a total unified grip strength score (in kilograms). The same handheld dynamometer was used throughout the study to ensure consistency.

3.7.1.4. Physical Activity – overall and recreational.

To obtain overall PA the PAQ-C question 1-6 responses were averaged to obtain a score between 1 and 5 with 5 represented the highest activity level. This value in analysis is referred to as overall PA level. For out-of-school recreational activity only the questions categorized under the physical activity sub-scale from CAPE (total 13 questions) were used for analysis. Specifically, from the PA scale the diversity dimension (i.e. frequency) was totaled based on the

number of activities the children said that they participated in, this value in analysis is referred to as Recreation PA.

3.7.1.5. Playground use and behavior.

Children's responses to questions about their favourite and least favourite areas to engage were coded by playground area (*n*=14) and then collapsed into the 5 common area types (field, court, tarmac, built equipment and nature; see Appendix I), for analysis frequency count was generated. The PEQ questions addressed children's frequency of play in an area, intensity of engagement in an area, and enjoyment, and were all Likert scale questions with 0 representing low frequency, intensity, or enjoyment and 5 representing maximum frequency, intensity or enjoyment. Three questions from the PEQ used a Likert scale. The first question regarding frequency (i.e. How often do you play here) 0 = not allowed in this area; 1 = not at all; 2 = not much; 3 = once in awhile; 4 = sometimes; 5 = almost always. The second question regarding intensity in the area (i.e. What do you normally do) 0 = Not permitted/do not go to this area; 1 = Sat down (talking, reading, doing school work); 2 = Stood around or walked around; 3 = Ran or played a little bit; 4 = Ran around and played quite a bit; 5 = Ran and played hard most of the time. The third question referring to enjoyment (i.e. How much do you like playing here) 0 = not at all/ not allowed;1 = not really; 2 = somewhat; 3 = quite a bit; 4 = sometimes; 5 = very much. Similar play space types (i.e. nature space comprised of Area 5 & 13) were then combined together and an average score was then calculated for the play space type. The PEQ area categorization included field, court, tarmac, built equipment and the nature space which can be viewed in Appendix I. The PEQ also asked children to list the type of activities they engaged in the different play spaces. All activities that children stated were categorized and coded using the lead researcher's knowledge of FMS and the primary motor skills used in the activities the

children listed. This was then reviewed by the supervisor (also using a motor skill list to give an understanding of the types of activities that children engaged in the different play space types).

3.7.2. Inter-rater reliability.

To ensure TGMD-2 scoring accuracy, inter-rater reliability was calculated. An expert researcher with previous experience using TGMD-2 scored a percentage of the TGMD-2 video recordings and then comparing the lead researcher's scores to those. Of the 55 (54 completed) participants in the study, 10% of the participants (n = 6) were scored by both the TGMD-2 expert and the lead researcher. Using the percent agreement method, inter-rater reliability was 95.1% for the Total motor skill score, 88.8% for the Object Control sub-test and 96.1% for the Locomotor sub-test (Osborne, 2008).

3.7.3. Did children's play behavior (frequency, intensity of PA, enjoyment and type of play) vary on different locations on the school playground? Did this differ by motor skill abilities or sex?

In order to address the first question posed for this study, descriptive statistics (means, standard deviations, measures of normality) were calculated for all variables to a) determine whether assumptions for parametric statistics were met and b) describe the sample in terms of average FMS scores, balance, grip strength, PA levels, active recreational PA pursuits (13 questions) and playground use and enjoyment. Frequency tables were used to identify the qualitative responses that children gave to their favourite and least favourite areas. Categories for the tables were based on children's responses. Further, descriptive statistics were compared to the TGMD-2 gross motor quotient scoring chart (Ulrich, 2000) and existing norms for grip and balance (stork stand). An analysis of variance (ANOVA) was used to evaluate whether the frequency, intensity, activity type, and enjoyment of participating in each area differed and

whether this differed by sex, and by motor skill (high/low). Scheffe's post hoc analysis was used during the comparison of each of the five play spaces.

3.7.4. Did children's motor skills, PA, strength or sex relate to where (area) and what children are doing (frequency, intensity, enjoyment and activity type) when they engaged on the school playground?

In order to address the second thesis question, Pearson's correlation coefficients were computed. Variables included in this analysis were: sex, age, stork stand score, grip strength score, CAPE recreational PA, TGMD-2 locomotor standard score, TGMD-2 object control standard score, TGMD-2 gross motor quotient, PAQ-C overall PA level score, scores for the frequency, intensity, activity type, and enjoyment of each play space type, and coded scores of where children engaged and whom they engaged with during their lunch and afternoon recess.

3.7.5. Did motor skills, PA, strength, and sex predict engagement in PA in different locations?

Linear regression was used to analyse the third thesis question posed in this study. The correlational analysis identified which variables were significantly related to the frequency, intensity, activity type, and enjoyment of the different play spaces and only those were entered into the regression equation with the exception of motor skill variables (gross motor quotient, locomotor and object control standard scores) which were always entered into the regression equation regardless of the correlation because this was a primary variable of interest. All variables were entered into the regression using forced entry.

Chapter 4: Results

4.1. Research Question 1: Did children's play behavior (frequency, intensity of PA, enjoyment and type of play) vary on different locations on the school playground? Did this differ by sex or motor skill abilities or sex?

A total of 54 children participated (mean age = 8.46yrs; *SD*= .667) with 31 participants being boys (mean age = 8.48yrs; *SD* = .728) and 23 participants being girls (mean age = 8.43yrs; *SD* = .591). Descriptive statistics for independent variables are shown in Table 1. Overall, the children that participated in this study had relatively low motor skill scores as the mean gross motor quotient fell within the "less than one percent" range in percentile ranking on the TGMD-2 conversion table. There were two participants that had high gross motor quotients with a score of 85 and 91 in comparison to the rest of the group which ranged from 46-79. Children were able to hold their stork stand for almost two-thirds of the maximum time of 30 seconds. Beyond the stork stand children's PA (overall and recreational PA) were quite low in comparison to the maximum score possible in each of the respective categories.

Table 1. *Descriptive Statistics for All Independent Variables Combined and by Sex*

Variable	Combined Mean (SD)	Boys Mean (SD)	Girls Mean (SD)
Age (in years)	8.46 (0.67)	8.48 (0.13)	8.43 (0.59)
Stork Stand (0 – 30 seconds)	19.22 (7.57)	19.70 (8.00)	18.57 (7.07)
Grip Strength (0 – 100 kg)	11.77 (3.32)	12.71 (3.50)	10.50 (2.63)
Recreational PA (0 – 13)	4.30 (2.46)	4.77 (2.45)	3.65 (2.39)
Locomotor (1 – 20)	4.56 (2.39)	4.13 (2.79)	5.13 (1.60)
Object Control (1 – 20)	3.11 (2.04)	3.00 (2.08)	3.26 (2.03)
Gross Motor Quotient	63.00 (11.19)	61.39 (12.72)	65.17 (8.52)
PA Level (0 – 24)	14.52 (5.21)	15.42 (5.22)	13.30 (5.06)

In evaluating the playground, the elementary school contained multiple play areas offering a variety of engagement opportunities for children, including: one field, five built structures, one court area, four tarmac spaces, and two nature space areas. Table 2 displays descriptive statistics of children's play behavior scores across the different school play spaces.

Table 2. *Description of Play Behavior (Frequency, Intensity, Enjoyment, PA type) Scores Across Areas of the Playground*

Play Behavior Type and Spaces	Mean	SD	Minimum	Maximum
Frequency				
Field Spaces (Score range 0-5)	2.65	1.12	1	5
Built Structures (Score range 0-5)	3.04	.97	1	5
Court Areas (Score range 0-5)	2.26	1.25	0	5
Tarmac Spaces (Score range 0-5)	2.43	0.98	0	5
Nature Spaces (Score range 0-5)	2.20	1.16	0	5
Intensity				
Field Spaces (Normally Do) (Score range 0-5)	2.80	1.50	0	5
Built Structures (Score range 0-5)	3.09	1.25	0	5
Court Areas (Score range 0-5)	2.52	1.91	0	5
Tarmac Spaces (Score range 0-5)	2.22	1.33	0	5
Nature Spaces (Score range 0-5)	2.02	1.61	0	5
Enjoyment				
Field Spaces (Like) (Score range 0-4)	2.41	1.17	0	4
Built Structures (Score range 0-4)	2.61	1.02	0	4
Court Areas (Score range 0-4)	1.89	1.50	0	4
Tarmac Spaces (Score range 0-4)	1.91	1.10	0	4
Nature Spaces (Score range 0-4)	1.93	1.29	0	4
Physical Activity Type				
Field Spaces (Score range 0-6)	2.30	1.63	0	6
Built Structures (Score range 0-6)	2.30	0.96	0	6
Court Areas (Score range 0-6)	2.11	1.88	0	6
Tarmac Spaces (Score range 0-6)	2.17	1.41	0	6
Nature Spaces (Score range 0-6)	1.83	1.59	0	6

Note. SD refers to standard deviation. Score ranges for the PEQ are: Frequency (0-Not allowed/do not play there; 1-not at all; 2- not much; 3-once in awhile; 4-sometimes; 5-almost always), Intensity (0-Not allowed/do not play there 1-Sat down; 2-Stood or walked around; 3-Ran or played a little; 4-Ran around and played quite a bit; 5-Ran and played hard most of the time), Enjoyment (0-Not allowed/do not play there; 1-Not really; 2-Once in awhile; 3- Sometimes; 4-Very Much), Activity (0-none listed or no activities; 1-low level of PA; 2-locomotor PA; 3-manipulative ; 4 = stability activities; 5 = imaginary games; 6 = multiple FMS activities)

Figures 2-5 show the frequency in which children identified certain areas as their favourite or least favourite area to engage in. From the PEQ, children's area of preference to play on the school playground were the built structures, such as the swings and fixed structures like monkey bars and platforms, mainly due to the opportunity to play with friends. Children's least favourite area to play was surprisingly the tarmac areas due to the environment their friends were not there (view Figure 5). The built structures as a favourite area was also reflected in their reported frequency of visits, children indicated frequenting the built structured areas the most. Figures 6 and 7 show the types of activities children liked to engage in during both their afternoon recess and lunch recess period (question 9 from the PEQ). Children identified locomotor activities as their particular activity type of choice during both periods. However, during the lunch recess period they equally engaged in more than one activity type, this is most likely due to the lengthen break period of the lunch recess in comparison to the quick afternoon recess break.

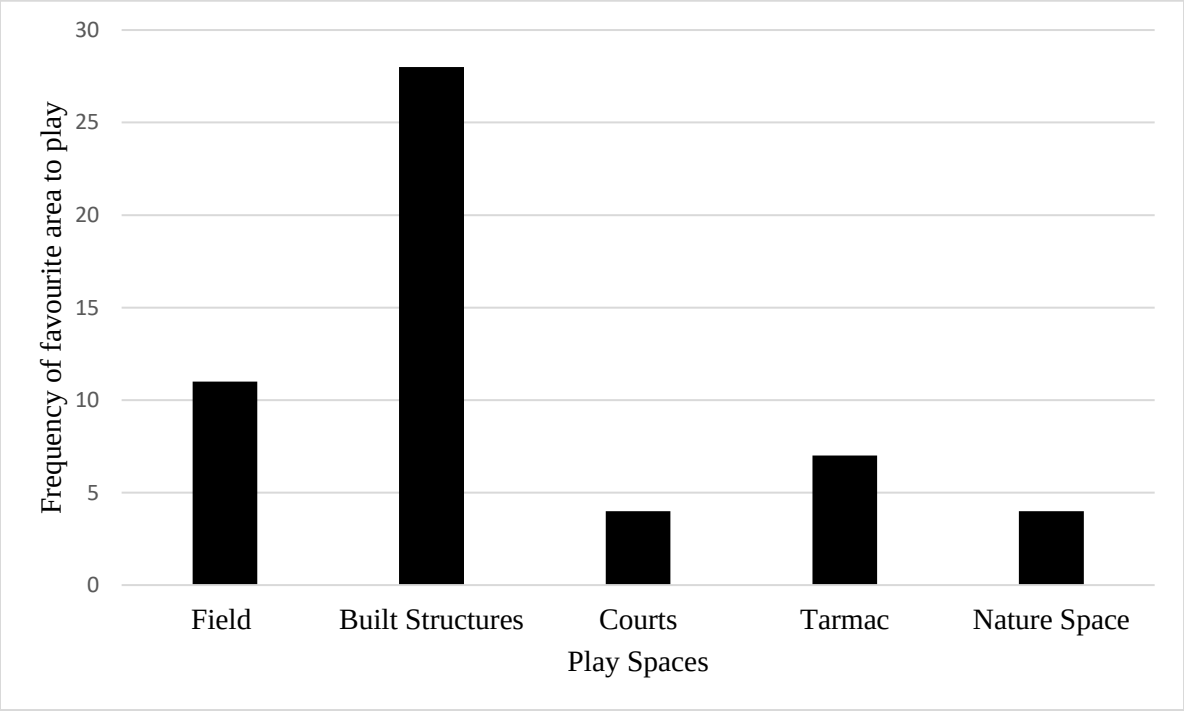

Figure 2. Frequency that Children Selected Different Favourite Areas to Play

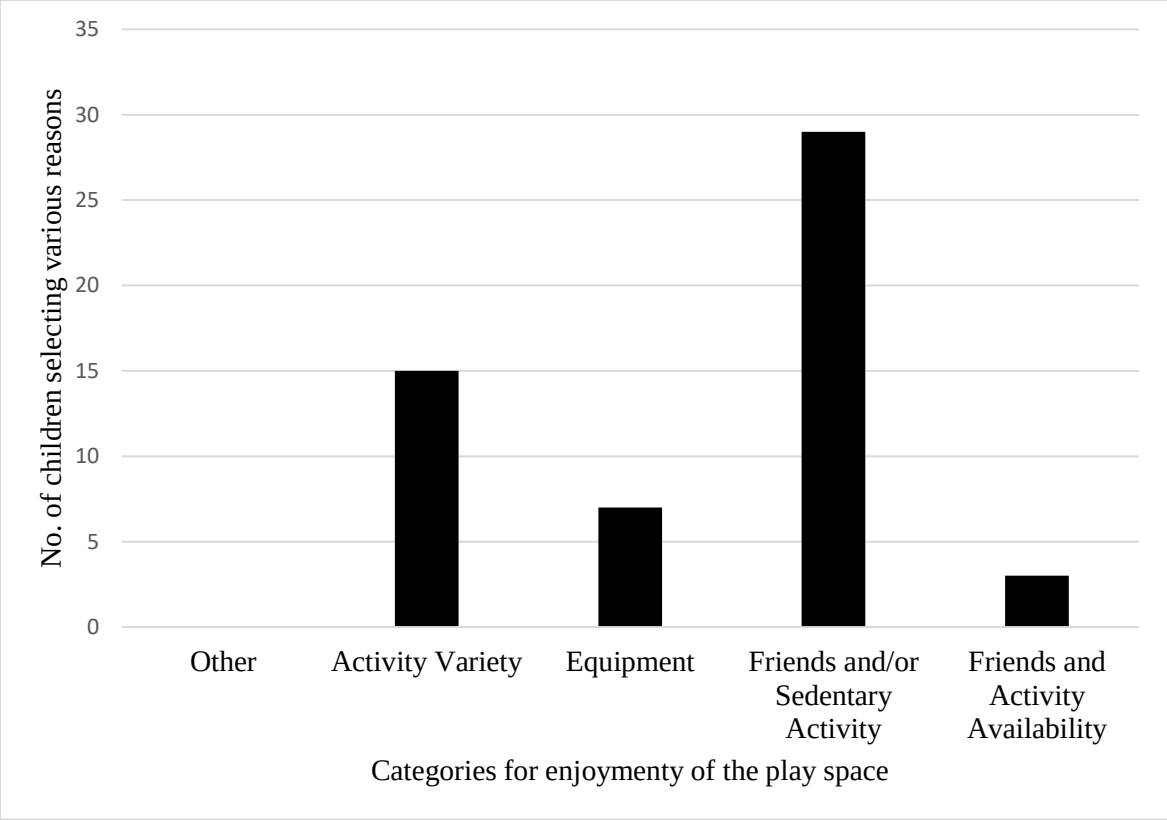

Figure 3. Reasons for Enjoying Favourite Area to Play by Frequency Count

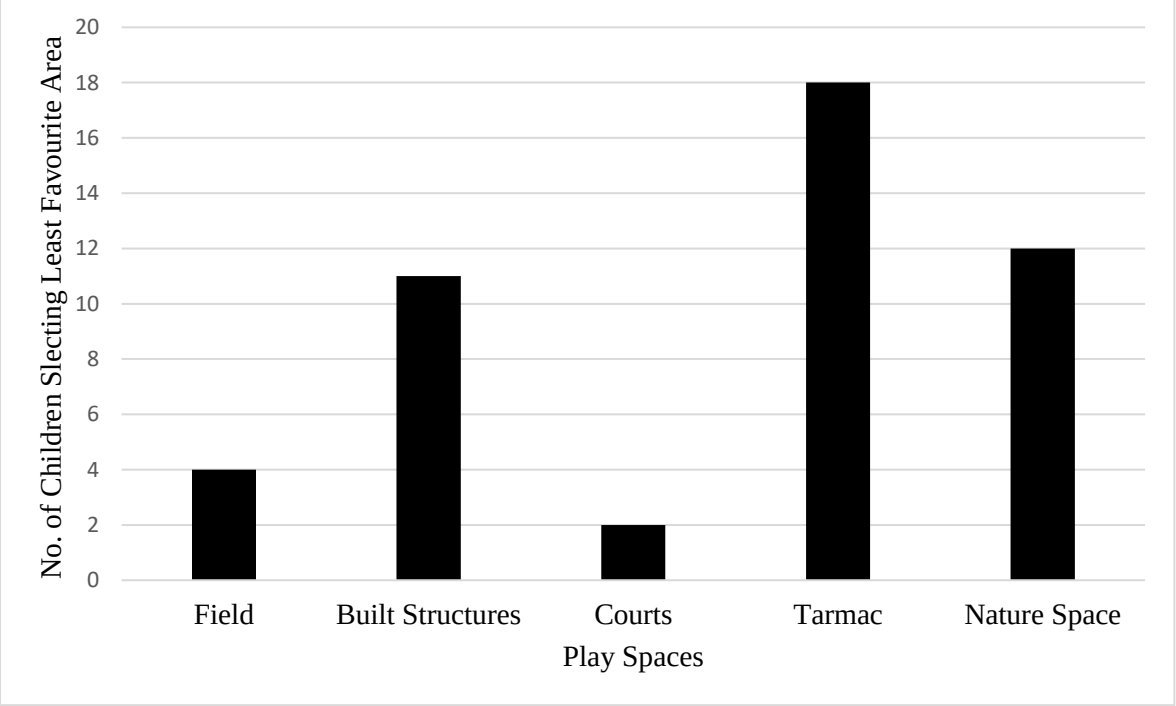

Figure 4. Frequency that Children Selected Different Areas as Least Favourite

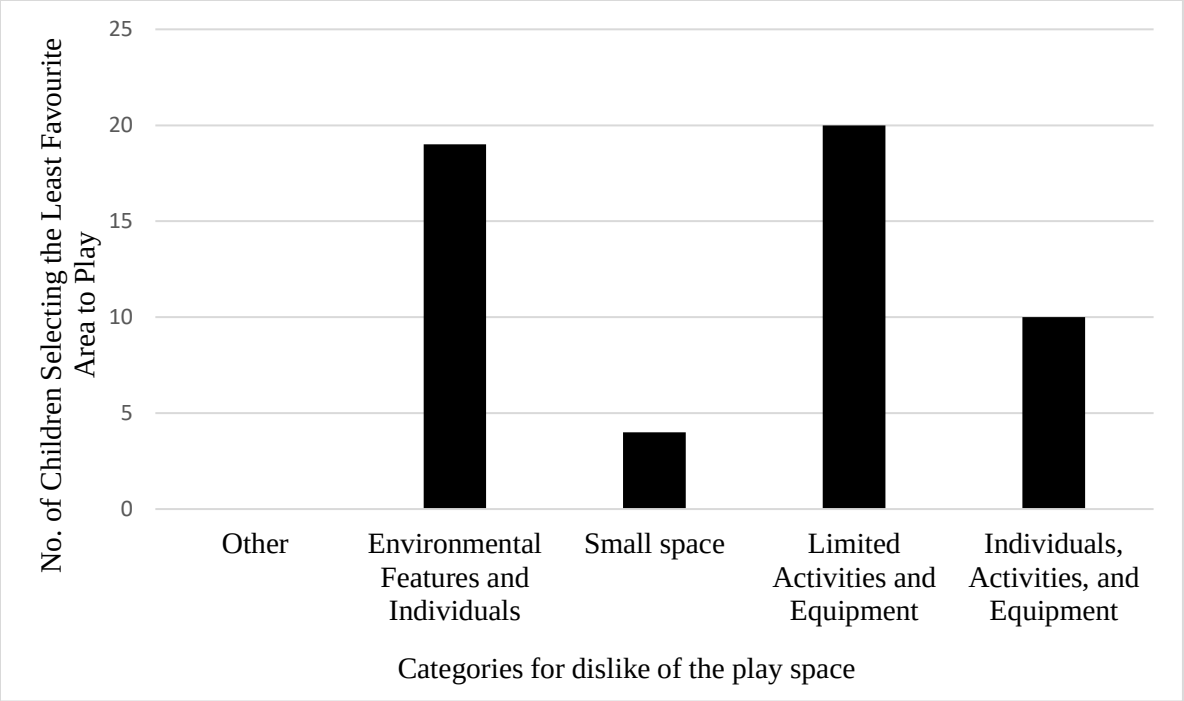

Figure 5. Reasons for Selecting an Area as Least Favourite Area to Play by Frequency Count

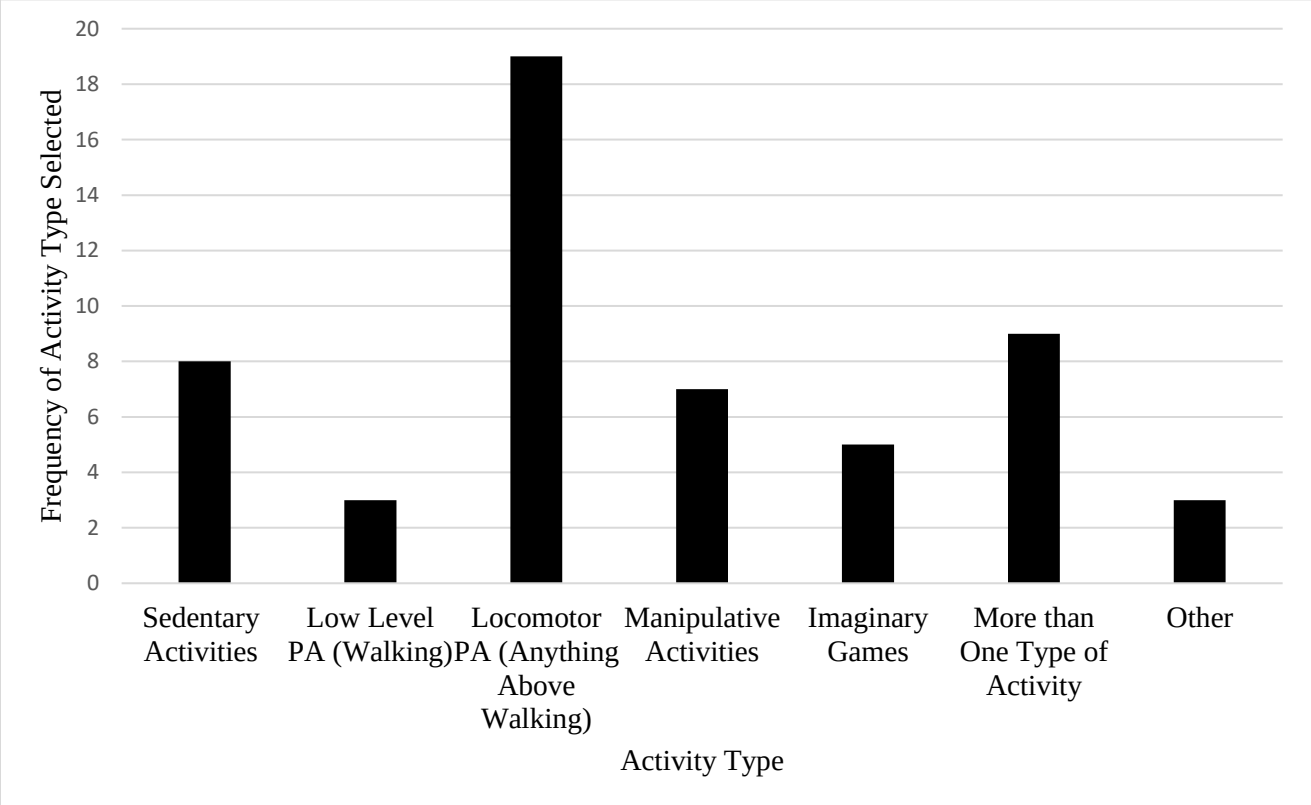

Figure 6. Reported Activity Types during Afternoon Recess

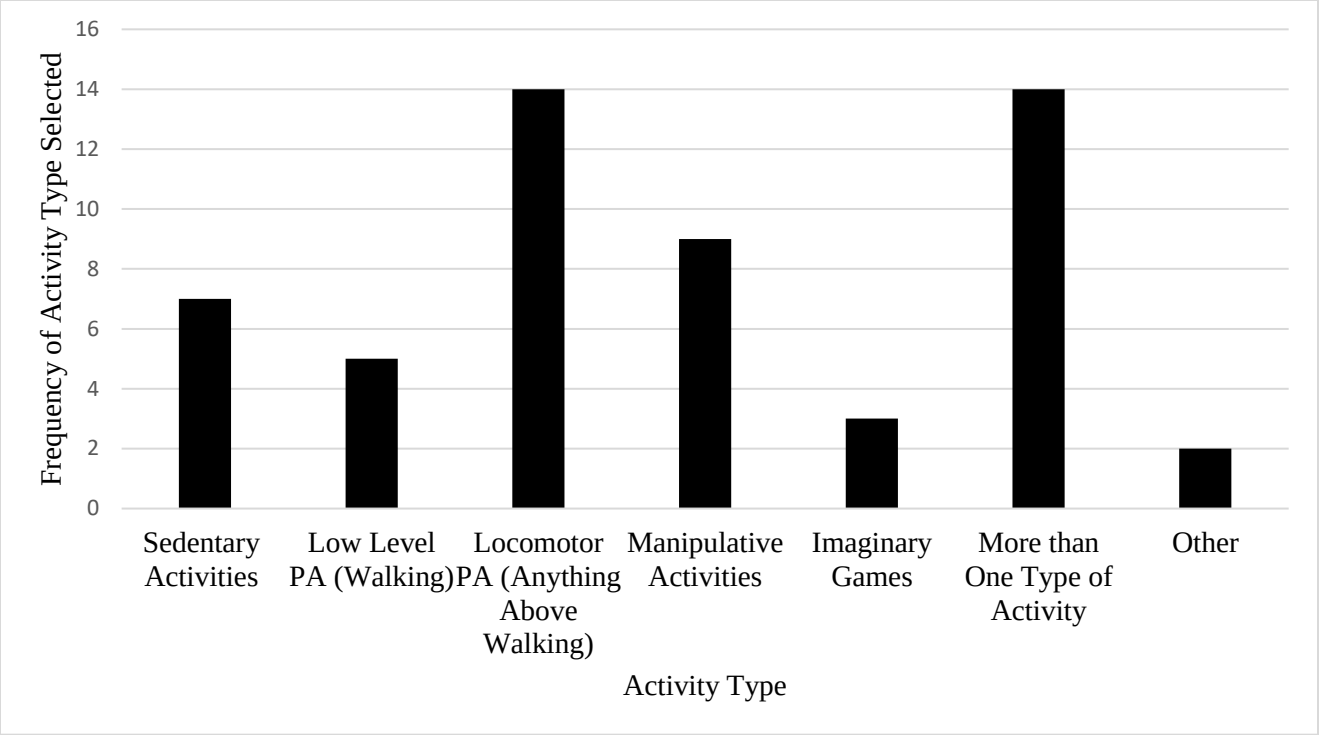

Figure 7. Report Activity Types during Lunch Recess

There was a significant difference in the frequency of usage across the different areas (F 4, 265 = 5.139, p = .001). Specifically, Scheffe's post-hoc test showed that built structures had a significantly higher frequency of use compared to courts and nature spaces. When examining intensity, there was a significant difference in intensity of PA reported in the different areas (F = 4, 257, p = .002), specifically there was a higher intensity when children used the built structure area compared to the nature space (p = .012). There were no differences in the reported types of activities that children engaged in within the different areas. Although, there were differences found in the enjoyment children reported in the different play space types (F = 4.085, p = .003), there were no significant differences between each play spaces type when the analysis was adjusted for the number of comparisons using Scheffe's post-hoc test.

4.1.1. Differences in Play Behaviors by Sex.

Frequency, intensity, type of activity, and enjoyment of playground areas were compared between sexes. Table 3 displays the means for each of these variables. Although no significant differences were found between boys and girls in activity type or intensity of engagement across any of the areas, there were significant differences in frequency and enjoyment. Boys frequented the field areas significantly more than girls and enjoyed the court areas significantly more than girls. Girls enjoyed the field and nature space areas significantly more than boys.

Table 3. *Description of Playground Variables by Area Category and Sex*

Area		Frequency Mean (SD)	Intensity Mean (SD)	Activity type Mean (SD)	Enjoyment Mean (SD)
Field	All	2.65 (1.12)*	2.80 (1.50)	2.41 (1.17)	2.30(1.63)*
	Boys	2.94 (1.12)	3.10 (1.54)	2.68 (1.08)	2.23 (1.33)
	Girls	2.26 (1.01)	2.39 (1.37)	2.04 (1.22)	2.39 (1.99)
Built	All	3.04 (.97)	3.09 (1.25)	2.61 (1.02)	2.20 (.96)
Structure	Boys	3.23 (.99)	3.35 (1.17)	2.77 (1.02)	2.39 (.99)
	Girls	2.78 (.90)	2.74 (1.29)	2.39 (.99)	1.96 (.88)
Courts	All	2.26 (1.25)	2.52 (1.91)	189 (1.50)	2.11 (1.88)*
	Boys	2.52 (1.34)	2.61 (1.78)	2.32 (1.51)	2.19 (1.67)
	Girls	1.91 (1.04)	2.39 (2.10)	1.30 (1.29)	2.00 (2.17)
Tarmac	All	2.43 (.98)	2.22 (1.33)	1.91 (1.10)	2.17 (1.41)
Spaces	Boys	2.48 (1.18)	2.13 (1.43)	1.87 (1.23)	1.90 (1.30)
	Girls	2.35 (.65)	2.35 (1.19)	1.96 (.93)	2.52 (1.50)
Nature Space	All	2.20 (1.61)	2.02 (1.61)	1.93 (1.29)	1.83 (1.59)*
	Boys	2.39 (1.28)	2.23 (1.69)	2.23 (1.36)	1.77 (1.56)
	Girls	1.96 (.93)	1.74 (1.48)	1.52 (1.08)	1.91 (1.65)*

Note. * denotes significant difference found between sexes at $p < .05$

4.1.2. Differences in play behaviors by motor skills

There were no significant differences between frequency of use of any area, activity type, intensity, or difference in enjoyment among the different play spaces between children in high and low motor competency groups. To view specific details of the ANOVA tables for frequency, intensity, activities reported, and enjoyment of each play area based on their gross motor quotient view Appendices P to S.

4.2. Children's Motor Skills and Strength and their Relationship to the School Playground Behaviors

Research Question 2: Did children's motor skills, sex or strength relate to where (area) and what children are doing (frequency, intensity, enjoyment, and activity type) when they engaged on the school playground?

Significant correlations are shown for each play space area in Table 4. With the exception of the gross motor quotient relating significantly to intensity of play on the courts, motor skills were not significantly related to the frequency, intensity, enjoyment, or activities that the children engaged in any of the other playground areas (i.e. field, tarmac, nature spaces, built structures). Nor were motor skills related to frequency, enjoyment, or activities on courts (See Appendix K to O for play area specific correlation tables). However, children's total PA level as measured by the PAQ-C was associated with between one and three characteristics of play behavior in all field spaces (see Table 4). Children's grip strength was also related to their PA intensity, as well as their enjoyment in the field space and recreational PA related significantly to frequency of play on tarmac spaces.

Table 4. *Variables significantly correlated with frequency, intensity, enjoyment, and activity type on each of the playground spaces*

	Frequency	Intensity	Enjoyment	Activity
Field spaces				
Sex	-.301* (.027)		-.270* (.049)	
Grip Strength	-	.296 (.030)*	.398 (.003)**	-
PA Level	-	.437 (.001)**	.273 (.046)*	-
Built Structures				
PA Level	.272 (.046)*	.396 (.003)**	-	-
Court Spaces				
Sex			-.339 (.012)	
Grip Strength	-	-	.328 (.016)*	-
Gross Motor Quotient	-	.273 (.045)*	-	-
PA Level	.310 (.023)*	.435 (.001)**	.437 (.001)**	
Tarmac Spaces				
Recreational PA	-.326 (.016)*	-	-	-
PA Level	-	.269 (.049)*	-	-
Nature Space				
Sex			-.273* (.046)	
PA Level	-.269 (.050)*	-	-	-

Note. () refers to *p* value, * refers to significant p < .05, ** refers to significant p < .001

4.3. Predictors of Engagement in Physical Activity in Different Locations

Thesis Question 3: Did motor skills, PA and sex predict engagement in physical activity in different locations?

4.3.1. Predicting engagement within the different play areas.

In predicting the frequency that children reported playing in field spaces the regression model created had an *r* squared of .091, which was significant ($F = 5.181$, $p = .027$). Within that regression model sex was the only significant predictor of frequency in the field spaces. In

examining the regression equation for intensity of PA in field spaces only PA level (PAQ-C scores) was a significant predictor. The regression equation predicting enjoyment of the field spaces was also significant ($F = 3.885$, $p = .014$); grip strength was found to be the sole significant predicator. The prediction model for frequency of play in the built structures area had an r squared of.178 which was significant ($F = 3.614$, $p = .019$). As shown in Table 5, PA level and object control scores made a significant contribution to frequency and intensity of playing in the built structure areas of the playground. Although, gross motor quotient scores were found to be correlated to children's intensity it was not found to be a significant predictor.

In examining predictors of the frequency, intensity, enjoyment, and play activities for court areas only the regression model for predicting PA intensity in the court areas was found to be significant ($r^2 = .122$, $F = 3.268$, $p = .013$). Specifically, children's overall PA level was found to be a significant predictor of children's frequency, intensity, and enjoyment of play in the court areas. No other variables were found to predict play behaviors in the court areas.

Overall, the predictor variables: object control, locomotor, gross motor quotient, and PA level did not significantly predict the intensity, enjoyment, and types of activities that children engaged in on the tarmac areas. Children's PA participation outside of school was found to be a significant predictor of frequency of playing on the tarmac. With the exception of sex none of the variables entered that were significantly correlated to frequency, intensity, and activity type in the nature spaces were found to be significant predictors of playing there. For detailed regression analysis tables for each play area view Appendices T to X.

Table 5. *Significant Variables for Regression Analysis for Frequency, Intensity, Type, and Enjoyment of the playground spaces*

	Play Spaces	Predictor Variables	B	SE B	β	Sig
Frequency						
	Field					
		Sex	-.675	.296	-.301	.027
	Built Structures					
		PA Level	.062	.025	.331	.016
		Object Control	-.170	.068	-.359	.016
	Courts					
		PA Level	.074	.032	.310	.023
	Tarmac Areas					
		Recreational PA	-.132	.053	-.330	.016
Intensity						
	Field					
		PA Level	.116	.041	.403	.007
	Built Structures					
		PA Level	.103	.030	.431	.001
		Object Control	-.192	.083	-.314	.026
	Courts					
		PA Level	.144	.046	.393	.003
Enjoyment						
	Field					
		Grip Strength	.106	.052	.301	.048
	Courts					
		PA Level	.100	.039	.347	.014
	Nature Areas					
		Sex	-.723	.354	-.281	.046

Chapter 5: Discussion

The overall aim of this study was to examine the relationship between individual factors, motor skill competence, current participation in PA (total and recreational), sex, strength and school playground play behavior. Using an ecological model, researchers have identified school playgrounds as an important micro-environment in which to promote PA, which inherently should allow for children to practice their motor skills. However, this model also suggests that there is a reciprocal interaction between an individual and the environments in which they spend their time. The current research has failed to address several other factors that may influence the development of motor skill proficiency. Specifically, Gallahue et al's. (2012) hour glass model and Stodden et al's (2008, 2014) Physical Activity and Motor Competence model of development highlights that there are individual and environment factors that will impact children's capacity to attain motor skill proficiency. Individual level factors that may influence playground behavior have not been thoroughly examined. Therefore, the purpose of this research was to examine: 1) where children played and their intensity, type of play and enjoyment in different playground areas and if this differed by high and low motor skill development or sex and 2) how their motor skill development, current participation in PA (total, and recreational), sex and strength related to and predicted where and how (frequency, intensity, type and enjoyment) they engaged on the playground.

To the researcher's knowledge this is one of a very few studies to incorporate an exploration of motor skill competence (as an individual factor) in an analysis of playground PA and play behavior and further explore their relationship with other individual level variables like overall and recreation PA levels, sex and strength. Past studies have examined how modifications to playground features impact PA levels and only a very few have addressed

where and why children are choosing to play on the school playgrounds or the relationship between motor skills and reported PA on those school play spaces. Even fewer have incorporated strength. In order to address the primary research objective three questions were posed: 1) Did playground behavior (frequency, intensity, type of play and enjoyment) differ on different types of play spaces on the school playground? And did it differ by sex or motor skill ability? 3) Did motor skills, grip strength and PA relate to where and how children engaged on the school playground 4) Did motor skill level, grip strength, sex or PA level predict engagement in different locations on the school playground.

Playground behaviors did differ on different play areas, although there were some more popular areas to play, children reported playing across all of the areas. PA level, sex, object control skills, recreational PA, and grip strength significantly predicted frequency, intensity, and enjoyment in different play areas, but this varied depending on the variable, the area, and the play behavior examined. This will be discussed more thoroughly in the context of the literature following. Of interest was that the self-reported reasons for playground play choices focused on other unmeasured factors that could be described as social or personal preferences. First among these was where friends were playing or where those that weren't friends were playing, followed by variety of terrain, activities and equipment available in that space and the size of the space itself.

First, it is important to note that the gross motor quotient showed that the children's motor skills were very poor (girls and boys). Although raw scores for both locomotor and object control scores had a range of 0-48, children scored on the very low end of this range for both. With a relationship between FMS and PA and cognitive and socio-emotional development over the short and long term emerging this is alarming, but not surprising. A number of Canadian

researchers have previously reported on this situation across children from kindergarten to Grade 5. Crane, Foley, Naylor, and Temple (2017) evaluated the changes between FMS and perceived competence in children from Kindergarten to grade two using the TGMD 2 to evaluate their motor skills and found that over the course of testing from Kindergarten to grade two children's motor skills did increase but their motor skill scores still ranged around the middle range of the possible maximal score for TGMD 2 testing (Crane et al., 2017). Tremblay et al. (2018) examined the physical literacy of children 8 to 12 years using the Canadian Assessment for Physical Literacy (CAPL) over 11 sites in Canada totaling 10,034 participants. CAPL was developed as a tool to evaluate Canadian children's physical literacy and contain assessments on motivation and confidence, physical competence (i.e. motor skills), knowledge and understanding, and habitual engagement in physical activity (Longmuir et al., 2015). Children achieve a score for each category and an overall CAPL score. These scores were then categorized based on their performance as: beginning, progressing, achieving, or excelling (Tremblay et al., 2018). Upon evaluation of all the children in the study by Tremblay et al. (2018) children's physical competence (max score of 32) score was just above half of the total amount of points that could be achieved in this category and this was also reflected in their total physical literacy score (max score of 100) (Tremblay et al., 2018). The results of this larger study highlight the low motor skills scores occurring nation wide and are not simply unique to the study conducted.

In terms of PA levels, the CAPE questionnaire sub-scale on children's physical activities participation revealed that a majority of children were involved in physical recreational activities outside of school time between once to 2-3 times a week. In comparison to children's PA during school time at baseline of the Action School BC intervention, children PA ranged from 157.9

minutes to 193.4 minutes of PA per week (Naylor, Macdonald, Zebedee, et al., 2006). Other studies have used CAPE and showed that children's outside of school participation (averaged) was similarly low (Field & Temple, 2017; Temple et al., 2016). The CAPE sub-scale on children's physical activities PA, showed there were some differences between sexes, in that boys were more active than girls and had overall higher recreational PA participation. This is similar to previous studies which have shown that boys were found to spend more time in both light and moderate physical activity (Demetriou & Höner, 2012; Fisher et al., 2005). Mirijafari, Temple, and Naylor (2015) study used CAPE and found that there were no differences in the levels of participations between the sexes in active physical recreation.

5.1. Children's Play Behavior

When frequency, intensity, and type of play as well as reported enjoyment on different play areas were examined there were some notable differences in how they behaved on the play spaces. Children reported visiting the built structures more and visiting the nature space less. Based on the current literature this finding is difficult to compare as few have examined children's preferences for engagement on the school playground. Holmes and Procaccino (2009) evaluated preschool children's play area preferences and found that boys preferred built structured areas such as swings and the jungle gym, whereas girls preferred the sandbox. However, when looking at elementary school children's play area preferences, Anthamatten et al. (2014) found opposing results in which boys preferred areas without equipment and girls preferred areas with equipment. With the limited research examining play area preferences it is difficult to determine whether the findings from this study are consistent with the current literature. However, it appeared that children didn't stick to one area of the playground, as the frequency of visiting the different play areas ranged from visiting the areas "not much" to "once

in a while". Children's play intensity in the different areas varied as well, however children reported the highest level of PA intensity on the built structure areas and the lowest PA intensity in the nature space (perhaps because the nature space at the study school was a small area focused with rocks and a few movable logs which might lead to more creative building activities in sitting positions rather than vigorous activities). These findings were somewhat supported by research from Haese, Dyck, Bourdeaudhuij, and Cardon (2013) who found that lower playground density decreased sedentary time and increased PA. In the context of the school in this study there were multiple built structures and a large field which provided several locations for children to engage. Furthermore, Herrington and Brussoni (2015) suggested that providing an affordance of play spaces promoted increased engagement with an end result of increased PA. This may also reflect their age or lack of equipment for manipulative skill-oriented play.

Children's overall enjoyment of the nature space, courts, and tarmac areas was low. Whereas, children's reported enjoyment was higher in the built structure and field play areas. In examining children's activity selection, the most reported activities across all the different play areas were locomotor activities. The least reported activity types varied between afternoon recess (low levels physical activity – walking), and during lunch recess (imaginary games and other activity types). There is limited research evaluating where children enjoy playing on the varying play spaces on the school grounds, and enjoyment of the different play spaces may vary within and between different school days (Hyndman, Benson, Ullah, Finch, & Telford, 2014). Therefore, the findings of enjoyment preference of the different play spaces could vary, the findings may be a reflection of the quality of the play areas at this elementary school and children at varying other schools may enjoy other play areas simply due to quality (Hyndman, Benson, Ullah, & Telford, 2014). Enjoyment of the built structure and field play areas could also

be due to the versatility and spaciousness that is provided in these play areas at this school, which have been suggested as important factors for physical active behaviors (Azlina & Zulkiflee, 2012; Delidou, Matsouka, & Nikolaidis, 2015).

5.2. Children's Motor Skills and Playground Usage

Motor skills were, for the large part, not related to playground behaviors across the different locations on the school playground, with gross motor quotient relating to reporting playing in the court areas and lower object control skill predicting an increased use of the built structure. Harten, Olds, and Dollman (2008) found overall differences in PA based on proficiency and sex but they did not look at playground behaviors and choices of play areas. Another study revealed a relationship among aerobic activity time, steps and higher motor proficiency in 5-6-year old (Kambas et al., 2012). Other studies have also revealed that children with higher motor skill scores were more likely to be more physically active in comparison to those with lower motor skills (Fisher et al., 2005; Williams et al., 2008). The lack of relationship between reported playground behaviors and motor skills in this study could be explained by a floor effect; the overall low motor skill scores of the children. Based on the gross motor quotient percentile ranking, all children fell in the lower percentile of scores with the highest being at the 27^{th} percentile. Limited score variability may also have limited the analysis. Furthermore, participants in this study came from a single school in a single location and there is a difference in population when comparing results to the current literature. Additionally, PA was only measured by self-report questionnaire and not through objective measurement. Finally, the norms used for comparison were not developed for a Canadian population and also represented a different time period.

Beyond the lack of a significant relationship between motor skill levels and playground behavior, when low and high motor skilled children were divided into groups there was no difference in their self-reported playground behavior. However, this finding should be interpreted with caution as the original plan to compare the top and bottom quartiles of children's motor skill development levels was limited by sample size. Instead, a dichotomous variable was used which meant many children in the middle two quartiles were included in either the high and low category, potentially masking their true motor skill status and affecting their results.

Further, motor skills did not predict the frequency, intensity, enjoyment, and types of activities that children took part in across most of the areas on the playground. Children's object control standard scores were found to be a significant negative predictor of the frequency and intensity in which children engaged on the built structures. This suggests that children with higher object control skill scores visited the built structures less and reported less activity when they did visit. This is not consistent with the findings of Barnett, van Beurden, Morgan, Brooks, and Beard (2009). These authors found that children's object control skills positively influenced their PA. It may be that object control skills predict positive engagement in other areas where their advanced skills are utilized e.g. the field or court areas. Due to the small sample size in this study and inability to divide the sample further to exclude those with average scores the definition of high motor skills was impossible to discern.

Current PA levels and sex predicted reported frequency in some, and intensity in most, areas of the playground. This is similar to findings in the literature. Specifically, a systematic review by Verstraete, Cardon, De Clercq, and De Bourdeaudhuij (2006) found that access to loose equipment contributed to both boys and girls increase in PA, however during morning recess access to games equipment was only effective in increasing girls PA. Conversely,

although PA in different playground areas has not been previously examined, a study by Harten et al. (2008) highlighted differences in play area usage; finding that boys but not girls increased PA in larger play spaces.

Grip strength was found to predict enjoyment on the field space. It is difficult to determine why grip strength influenced children's enjoyment of the field as the only playground literature available reveals that access to built structures assists children in improving their muscular endurance (Gabbard, 1983). It is possible, that as Wind et al.'s (2010) research suggests that grip strength is a general indication of someone's muscle strength or overall fitness, and therefore allows them to engage in a variety of spaces on the open field space.

5.3. Strengths of the Study

There are several strengths to the study that could enhance its potential contribution to the literature First, by examining many individual level variables (sex, playground behavior, physical activity, grip strength and motor skills) provide a more comprehensive understanding of children's engagement on the playground emerged. Specifically, this study illuminated where children played, the intensity and type of play in those areas and their enjoyment levels within those areas. As well, it examined whether this was predicted by motor skill competency, PA levels (overall and recreational), strength, and sex. The information collected from this study provides a better understanding of children's' playground behavior and factors to consider when implementing future PA interventions on the school grounds. For instance, with object control scores found to be a negative predictor of children's frequency and intensity on the built structures, this could suggest that the built structures are an area to implement PA interventions for those with lower motor skills who were more likely to play and enjoy playing there. It also highlights the importance of children's overall PA levels to their playground behaviors.

This study also used a variety of methods to examine the research questions. In doing so, it incorporated the use of direct measures; the valid and reliable TGMD-2 was used to assess motor skills and the hand dynamometer to measure grip strength. The Physical Activity Questionnaire for Children (PAQ-C) is also a reliable and validated survey instrument and the PEQ was pilot tested and reliability demonstrated in an older group of children in the same school. This questionnaire was also the first questionnaire developed to evaluate children's self-reported enjoyment, PA intensity, frequency, and the type of activities children engaged in on different play areas. The different play areas were well defined with photographs to ensure children knew what was being referred to. All researchers involved in this study were trained and then used consistently throughout the data collection period, to improve the consistency of instructions. All researchers involved also had past experience using the TGMD-2, stork stand and the CAPE questionnaire. All scoring for the TGMD-2 was done by the lead researcher to ensure consistency among the scores.

5.4. Limitations of the Study

Although, there are several strengths to this study, particularly with the novelty of the research and its contribution to children's playground literature there are some limitations that must be acknowledged. First, only children in grade 2 and 3 (ages 6-9 years) in one school and in one school district in Canada were examined in this study. This limits the generalizability of the results to other playgrounds, schools, and children. The results could have been influenced by factors such as socioeconomic level in the area, access to sports outside of school, playground style and structure and overall resources for PA. It should be noted that the playground at this school contained multiple different play areas offering a variety of engagement opportunities for children. Further research is required s to determine if having multiple play areas impacts

engagement. Previous research has found that there is a variety of play areas on school grounds both in size and quantity (Lim et al., 2017). The breadth of play areas on the school grounds could have influenced how children engaged. This was highlighted by the fact that children often stated they engaged in multiple areas on the school grounds during either of their breaks. This study also only focused on children in grade 2 and 3. Although some research suggests that children should have achieved proficiency in FMS during these grades, additional literature has shown that children beyond this age group have yet to achieve proficiency in the FMS (van Beurden et al., 2003).

Although, there was a high consent rate the sample size was still limited. This small sample size could result in outliers having a large influence on the data analysis. There were two participants that had high Gross Motor Quotients in comparison to the rest of the group which were below the norms. This also delimits the findings to this age category, and therefore further research is needed to examine how children in other age categories use school playgrounds. As previously discussed, this small sample size also made it difficult to generate an interquartile range and to appropriately evaluate how children of high and low motor skills interacted with each play area. The small sample size resulted instead in using the mean motor skills score to categorize children as high or low motor skills; consequently, many children falling into the mid-range of the distribution were categorized as high or low motor skills. This is also the first time that the PEQ has been used and it is vulnerable to the common limitations of self-report. Although, it was tested for its reliability continued evaluation of the questionnaire is needed to establish its validity by comparing it with direct observation or accelerometry.

5.5. Conclusion

Overall, this study suggests that most children actively engaged in multiple areas of their school playground and that for the most part motor skills were not related to where or how they played while current PA levels were. Active children were more active on the playground. Playground behavior contributes to overall PA levels but also appears to benefit from them. Though object control skills predicted less engagement on the built structures this may be because traditional sports and games, that those with well-developed skills play, are typically played on field and court spaces. When provided with an adequate amount and variety of areas to engage, there were minimal differences in the reported type of play and level of PA between girls and boys. Boys and girls differed in their levels of enjoyment in three areas; fields, courts, and nature spaces and reported frequency of playing in field and nature spaces. Thus, school playground-based PA interventions could potentially be assisting all children (boys and girls) of both high and low motor proficiency and enhancing their PA levels. Two findings of note were the positive relationship between playing on court and field spaces and grip strength, which might be a marker for overall fitness and, evidence of the importance of interpersonal influences on playground choices (where friends played mattered). This highlights the need to incorporate interpersonal factors and fitness into future models and intervention planning.

5.6. Future Directions for Playground Research

The ecological model suggests that school playgrounds are an important area to promote PA for children. This is highlighted by the current research which has attempted to intervene and promote PA on school grounds. However, the current research has failed to identify additional individual factors (i.e. grip strength, motor skills, playground enjoyment, playground preferences, etc.) as elements that can influence how children engage on the school playground.

This could have an impact on how future researchers intervene on the school ground to best target those of lower motor skilled to be more physically active. Therefore, further research is needed to identify children's individual factors that consistently influence their PA engagement, and whether these are specific to the individual or there are general factors across all children. Furthermore, additional research is needed to examine the validity of self-report and to highlight whether there are playground specific elements across multiple school grounds that are related to different types of engagement as past research has already identified that varying elements on the school grounds encourage different types of motor skill opportunities.

The findings of this thesis also have implications for practice. They highlight the importance of understanding children's play choices from their perspective. Specifically, school staff and health promotion practitioners involved in schools need to pay attention to and target PA interventions in popular school play spaces. In addition, interventions should incorporate strategies to engage friendship groups and enhance social factors. Based on the limited findings in this study and the current literature related to motor skills and playground engagement, paying attention to where children of differing motor skill abilities play are important to maximize playground benefits for all. It may also be important for practitioners to understand the differing types of play that children are engaging in for both developmental and health goals. Finally, the role of overall PA levels in playground engagement and motor skill development highlights the need to continue to promote PA in the multiple settings in which children live, learn, and play.

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Appendix A - Literature Review Table of Playground Interventions

Authors and year	Sample			Method	Design	Measures	Intervention	Findings
	Age group	Size	Location					
(Anthamatten et al., 2011)	6-11 yrs	-	Denver, Colorado	SOPLAY	Purposeful selection, cross sectional	PA monitoring and contextual variables	Renovations	Usage on renovated ($p = .008$), MVPA ($p = .602$)
(Anthamatten et al., 2014)	5-11 yrs	-	Denver, Colorado	SOPLAY	Purposeful selection, descriptive	PA monitoring and contextual variables	Renovations	37.9% MVPA total from scans, MVPA ($p < .001$) across zones
(Blaes et al., 2013)	6-11yrs	426	France	Accelerometers (2s)	Cluster sampling	Anthropometric measurements PA monitoring	Zone markings	MPA (+1.1%, $p < 0.05$), VPA (+0.3%, $p < 0.05$), MVPA (+4.3%, $p < 0.001$), SED 9-

								2.8%, p < 0.05)
(Bohn-Goldbaum et al., 2013)	2-12 yrs	-	Sydney, Australia	SOPARC Interviews	Quasi-experimental	PA monitoring and contextual variables	Playground Renovations, community	MVPA (p = 0.73), Girls MVPA (p = .04) First time visitors = 13%
(Brown et al., 2009)	3-5yrs	5	United States of America	OSRAC-P	Single Case alternating treatment	PA monitoring	Teacher encouraged physical activity	Increase MVPA
(Bundy et al., 2011)	5-7 yrs	18	Sydney, Australia	Accelerometer counts, qualitative	3-year cluster randomized controlled trial	PA, self-concept, social skills, social interactions, after school time use and anthropometric measures	Unstructured materials and adult based interventions	Incomplete study
(Cardon et al., 2009)	4-5yrs	83	Belgium	Accelerometers (15s)	Cluster randomized control trial	PA Monitoring	Playground designs Real	MVPA (p = 0.07), VPA (p = 0.13), MPA (p <

							play equipment	0.01). Boys lower SED than girls ($p < 0.001$) and MPA ($p < 0.001$)
(Colabianchi et al., 2009)	-	-	Cleveland, Ohio	SOPLAY	Cross-sectional, purposely selected	PA and Contextual variables outside school hours	Renovation	Number of children on renovated ($p = .06$), MVPA ($p > .05$)
(Colabianchi et al., 2011)	-	-	Cleveland, Ohio	SOPLAY	Cross-sectional, purposely selected	PA and Contextual variables outside school hours	Renovation	Mean = 2.5, 52% of persons observed on the playground were in MVPA
(Engelen et al., 2013)	5-7yrs	226	Australia	Accelerometers (5s)	Cluster randomized trial	Anthropometry BMI Demographics Play space	Recyclable loose material Teacher parent intervention	MVPA (+12%), boys more active than girls, MVPA (+1.8min $p < 0.05$), SED (2.1min p

								< 0.05), 2-year post test (+1.7 minutes, p > 0.05)
(Hannon & Brown, 2008)	3-5yrs	64	Salk Lake City, Utah	Accelerometers (15s) OSRAC-P	Convenience selection	PA Monitoring	Portable real play equipment Teacher prompts	SED decrease (p < 0.001), light PA (p < 0.001) MPA (p < 0.001), VPA (p < 0.001)
(Huberty et al., 2011)	Grade 3,4,5	93	Midwest United States	Accelerometers	Convenience selection Time series intervention	PA Monitoring BMI Demographics	Staff training, Zone marking, real equipment	Significant increase in MVPA (2.5min p < 0.001) and VPA (2.2min (p < 0.001) at recess and whole school day
(Loucaides et al., 2009)	Grade 5,6	89 (E) 69 (C)	Cyprus	Pedometer	Cluster randomized	PA Monitoring	Playground designs, equipment	Gender (p < 0.001), Increase in steps (p < 0.01)

(Maxwell et al., 2013)	3-5	57	-	Observation	Convenience sampling	Play behavior	Playground equipment and loose parts	Boys more functional play Girls more fantasy play Loose equipment increased another type of play
(Ridgers et al., 2010a)	Grade K-7	470	England	Heart Rate Accelerometers	Quasi-experimental, random selection	PA Monitoring Anthropometry Recess duration	Zone playground markings, real equipment	MVPA, VPA ($p < 0.05$). Effects decreased by12 months
(Ridgers et al., 2007)	Grade K -7	232 boys 238 girls	England	Heart Rate telemetry Accelerometers	Stratified random sampling	PA Monitoring Anthropometry Heart Rate	Playground Zone markings	MVPA (+4%, $p < 0.05$), VPA (+2.4%, ($p < 0.05$)
(Stratton, 2000)	5-7yrs	36 (E) 24 (C)	England	Heart Rate telemetry	Quasi experimental Stratified random sampling	PA monitoring Body Mass Stature	Painted fluorescent designs	MVPA ($p < 0.01$), VPA ($p < 0.05$). Increase of

								6 min of MVPA
(Stratton & Mullan, 2005)	4-11yrs	99	England	Heart Rate telemetry	Stratified random selection, quasi experimental.	PA Monitoring Body Mass Status	Playground fluorescent designs	MVPA increase ($p < 0.01$), VPA ($p < 0.03$). MVPA exceeded 50% of recess time
(Zask et al., 2001)	5-12 yrs.	3912	Australia	CAST	Stratified random selection at the school and district level	PA monitoring, contextual variables, teacher behavior	-	51.4% boys and 41.6% of girls were engaged in MPVA during break periods

Note. OSRAC-P = Observation System for Recording Physical Activity in Children-Preschool Version, PA = physical activity, BMI = body mass index, (E) = experimental group, (C) = control, MPA = Moderate Physical Activity, MVPA = moderate to vigorous physical activity, VPA = vigorous physical activity, SOPARC = System for Observing Play and Recreation in Communities, CAST = The Child Activity Scanning Tool.

Appendix B – University of Victoria Human Research Ethics

University of Victoria

Human Research Ethics Board
Office of Research Services
Administrative Services Building
PO Box 1700 STN CSC
Victoria British Columbia V8W 2Y2 Canada
Tel 250-472-4545, Fax 250-721-8960
Email ethics@uvic.ca Web www.research.uvic.ca

Certificate of Approval

PRINCIPAL INVESTIGATOR:	**Christopher Lim**	**ETHICS PROTOCOL NUMBER** Minimal Risk - Delegated	**14-444**
UVic STATUS:	**Master's Student**	ORIGINAL APPROVAL DATE:	25-Feb-15
UVic DEPARTMENT:	**EPHE**	APPROVED ON:	25-Feb-15
SUPERVISOR:	**Dr. Patti-Jean Naylor**	APPROVAL EXPIRY DATE:	24-Feb-16

PROJECT TITLE: **Examining the Relationship between Physical Activity, Fundamental Motor Skills, and Playground Use in Elementary School Children**

RESEARCH TEAM MEMBERS Co-investigators (UVic): Dr. Patti-Jean Naylor, Dr. Viviene Temple

DECLARED PROJECT FUNDING: **None**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

Dr. Rachael Scarth
Associate Vice-President Research Operations

Certificate Issued On: 25-Feb-15

14-444 Lim, Christopher

Appendix C – School District 61 Request for Research

Saanich Schools
Great Places to Learn & Safe Places to Be

REQUEST FOR RESEARCH

1. Title of Research Project: Examining the Relationship between Fundamental Motor Skills, Physical Activity, and Playground Use in Elementary School Children
2. Brief description of research project: This project will examine how children of high and low motor skills engage on the playground, in the types of motor skills the use, where they are actively engaged, and at what physical activity intensity level they are engaged at during school break periods at Sidney Elementary School.
3. Your project involves (check one or more boxes):

[x]	Students – Grade levels 1-3	[ ]	Principal
[ ]	Teachers	[ ]	Trustees
[ ]	School District Staff	[ ]	Parents
[ ]	Other		

4. Involvement in your project by School District 63 employees, students and parents is optional:
   [ ] Yes [x] No
   Please indicate level of involvement required:
5. The timeline of your actual involvement in our School District:
   From: January 2015 to April 2015
6. Approximate date that SD #63 may look forward to receiving the results of your project:
   June 2015
7. University Human Subjects Approval Form attached:
   [ ] Yes [x] No Expected date of completion: Beginning of January 2015
8. Please submit a copy of the entire package (including this cover sheet as the first page) to:
   Shannon Davies
   Office of the Assistant Superintendent of Schools

Christopher Lim
Name (PLEASE PRINT)

Signature

School of Exercise Science, Physical and Health Education UVIC PO Box 1700 STN CSC Victoria, BC V8W 2Y2 Canada
Address including postal code

Phone Number

Email address

Dec 11th 2014
Date

Appendix D – Consent Form

University of Victoria | School of Exercise Science, Physical & Health Education

Relationship between Physical Activity, Fundamental Motor Skills, and Playground Use In Elementary School Children

Your child is being invited to participate in a study entitled "The Relationship between Physical Activity, Fundamental Motor Skills and Playground use in Elementary School Children" This study is being conducted by Master's of Science Candidate Christopher Lim and Drs Patti-Jean Naylor, and Viviene Temple from the School of Exercise Science, Physical and Health Education at the University of Victoria. If you have further questions you may contact or Christopher Lim at 604-726-5627 or chrislim@uvic.ca or Dr. Patti Jean Naylor at (1) 250-721-8373 or pjnaylor@uvic.ca

Aim and Objectives

The aim of this research is to understand the relationships between elementary children's gross motor skills, physical activity levels, and playground use during school recess periods. We want to see whether children in grade 2, and 3 actual gross motor competence influences their physical activity levels, their motor skill use, and their engagement on school grounds.

Importance of this Research

Less than 15% of children in British Columbia meet Canada's physical activity guidelines for children and a study published entitled the *Fitness of Canadian Children and Youth* indicates that the fitness levels of children have declined since 1981, regardless of age or sex. These statistics are alarming and point to an urgent need to help children's stay engaged in physical activity.

Research suggests that actual motor skill competence is associated with time and intensity of physical activity, as well that physical activity varies in different locations on school grounds. However, the impact how children motor skill abilities influences their engagement on school grounds, how/where they interact, and the motor skills they practice has not been studied.

This research will be the first to examine the relationship among these three factors in elementary school children. Ultimately, our intent is to help teachers, schools, and school districts enhance physical activity participation by helping children optimize their fundamental motor skills (competence).

Participants Selection

Your child is being asked to participate in this study because she/he is in Grade 2 or 3 in Sidney Elementary School in School District 63.

What is involved

Physical Education Class

During scheduled physical education time your child will be videotaped performing 12 fundamental motor skills. These are the: run, hop, gallop, leap, slide, jump, catch, kick, throw, underhand roll, t-ball strike, and bounce. We videotape the skills so that we can accurately record the parts of each skill and to minimize the time it takes to complete all of the skills during physical education. If you do not consent, your child will still participate in his/her regular physical education class as the motor skills are part of the school curriculum, but we will know from the classroom teacher not to video record him/her. Your child will also complete balance and grip strength skills and three questionnaires. One questionnaire focuses on identifying the types of activities they do outside of class time, and a picture-based questionnaire about their physical activity participation. The third questionnaire will assess where children like to engage on the playground and what they like to do during recess. We are also asking you about your child's age, gender, and whether your child has a

disability as these factors can influence motor skill development and participation in physical activity. We will only videotape consented children in their physical education class as they perform their motor skill exercises. We will not share or show the videos.

Inconvenience

Approximately 35 minutes of class time, and two physical education lessons, will be devoted to this project.

Risks

There are no known additional risks to your child's participation in this study

Benefits

Your child's participation in this research will help us better understand the role that motor skill development plays in physical activity participation; and may help reverse the decline in fitness/physical activity among Canadian children. The fundamental motor skill test results will also help your child's teacher plan their physical education curriculum.

Voluntary Participation

Your child's participation in this research must be completely voluntary. Choosing not to participate in this study will in no way effect your child's physical education lessons. All children in the class will do the fundamental motor skills in physical education, but only the data from consented children will be used for research purposes. If your child does participate, she/he may withdraw at any time without any consequences or any explanation. If she/he does withdraw from the study her/his data will not be used in the study and will be destroyed.

On-going Consent

One of the goals of this project is to track how children's motor skills impact how active they are and what motor skills they use on the playground based on their motor skills. Therefore, it is assumed that ongoing consent will be given for the duration of this study (April 2015 – May 2015). If the project is required to go beyond this date an updated consent will be distributed to ensure your consent and your child's consent is still given. Before each session, we will ask children verbally if they wish to take part in the activity.

Anonymity and Confidentiality

Your child's participation will not be anonymous as the fundamental motor skill data will be collected during physical education. There will be many small groups of children performing motor skills at the same time; therefore, your child will only be performing in front of a few children. The data we collect will be entered into the computer without names and all presentations will refer only to group data.

Dissemination of Results

Aggregated data from this project will be presented to School District 63 and at professional meetings. Additionally, articles will be published and the graduate student will use the data for his theses. The fundamental motor skill data will also be provided to your child's class teacher and to the school. Your child's teacher will receive information about each child's motor skills and the school will receive scores and for the class as a whole.

Disposal of Data

The video data and computer files will be erased by a University of Victoria information technology professional and surveys will be shredded after the dissemination of results have been completed in the areas noted above. Specifically, the video data will be erased and surveys will be shredded five years after data collection, and computer files (without names) will be kept in a secure database for 15 years.

Contacts

Individuals that may be contacted regarding this study include Christopher Lim Master's of Science Candidate PH: 604-726-5627 or email: chrislim@uvic.ca or Dr. Patti-Jean Naylor PH: (1) 250-721-8373 or email: pjnaylor@uvic.ca.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of your child's participation in this study and that you have had the opportunity to have your questions answered by the researchers. We also ask that your child "signs" below to indicate that he or she is happy to be involved in the study.

_____ _____

Child's Name *Child's Signature*

_____ _____ _____

Parent Name *Parent/Guardian Signature* *Date*

_____

Parent Contact (e-mail or phone number)

To help us describe motor skills and physical activity participation more specifically we ask that you provide the following information about your child:

1. Date of birth: _____ 2. Gender: Boy ❑ Girl ❑
(day/month/year)

3. Does your child have a disability? Yes ❑ No ❑

If yes, please describe _____

PLEASE COMPLETE THE INFORMATION ON THE BACK OF THIS PAGE AND RETURN IT TO SCHOOL IN THE ENVELOPE PROVIDED.

University of Victoria | School of Exercise Science, Physical & Health Education

The Relationship between Physical Activity, Fundamental Motor Skills and Playground Use in Elementary School Children

If you have any questions you may call or email the following people in the School of Exercise Science, Physical and Health Education at the University of Victoria.

Christopher Lim	PH: 604-726-5627	chrislim@uvic.ca
Dr. Patti-Jean Naylor	PH: (1) 250-721-8373	pjnaylor@uvic.ca

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Appendix E – Letter of Information

University of Victoria
Exercise Science, Physical & Health Education

Information Notice

Dear Parents and/or Guardians,

Sidney Elementary School is participating in a playground physical activity project in partnership with The University of Victoria (UVic).

The project is being conducted to determine whether the addition of a nature scape and equipment to the playground will affect physical activity levels, group size participation and interaction, as well as where children play. With the renovation to the nature scape being moved to the fall, we hope to determine how the addition of loose equipment to a portion of the school grounds can impact the conditions noted, as well as improve physical activity levels. If the renovations and the addition of loose equipment are successful in increasing physical activity levels the results can then be shared with other communities and schools to help promote and maximize physical activity opportunities for children during their break periods. A summary of the results from this study will be provided to parents through Sidney Elementary school and we will make a presentation at the Parent Advisory Committee meeting if desired.

The nature scape and loose equipment project involves UVic researchers taking general observation scans of physical activity levels, contextual variables, and children's interactions before and after playground renovations. Observations for the addition of loose equipment will occur from March 30th 2015 – June 2015, while nature scape renovation observations will occur from September 2015 to October 2015, all observations will be taken on the school grounds during lunch break periods.

All observations on the playground are completely anonymous (no children are identified) and no video, pictures, or audio recordings will be made during this project. The researchers will not be interacting with the students. They will be using a coding system to record the factors noted above for each area on the playground, as well as counting the number of students in those areas.

Researchers will be easily identified on the playgrounds during break periods as they will be wearing University of Victoria clothing, a school visitor badge, and will be signed in to the school visitor log. If you have any questions please feel free to contact Dr. Patti-Jean Naylor, University of Victoria at pjnaylor@uvic.ca or (1) 250-721-8373 or Chris Lim, University of Victoria Master's student at chrislim@uvic.ca or 604-726-5627.

Appendix F – Stork Stand Protocols

Protocols for Assessing Stork Stand (Temple et al., 2016)

1. A stopwatch, pencil, and a recording sheet with the child's code will be needed and prepared prior to commencing stork stand testing
2. Prior to beginning the stork stand, have all children sit on a bench in order of assessment and explain to them what activity they are going to be doing at that station (i.e. Stork Stand). Explain to the children that they will perform two trials on each leg. Demonstrate and explain the stork stand: children will stand on one foot with the sole of the foot they are not standing on placed on the side of the knee of the standing foot, their hands will be placed on their hips with their fingers facing forward (i.e. front of their hips), they will hold this position for as long as they can for a maximum of 30 seconds, time will be stopped if they break this position.
3. One child will go at a time, they will alternate legs in which they stand on when performing the two trials on each leg
4. During each trial, stop time, if the position is broken, or if the child holds the position for the 30 seconds. After each trial ensure to record the time, they held the position for. Also make sure to record which leg they were standing on while holding the stork stand position.

*Note: If the child completed the maximum time of 30 seconds on their initial trial of one leg, they do not need to do the second trial for that leg

Appendix G – Grip Strength Protocols

Protocol for Handheld Dynamometer – Grip Strength Test (Canadian Society For Exercise Physiology, 2015)

1. A pencil, and recording sheet with the child's code will be needed and prepared prior to commencing grip strength test
2. Have group of children stand around the area in which grip strength testing will occur
3. Ask the child to grasp the grip from the handheld dynamometer between the fingers and palm at the base of the thumb
4. The grip will be adjusted to the second joint of the fingers fits under the handle
5. Child will hold the dynamometer in-line with the forearm at the level of the thigh and away from their body
6. Child will squeeze the dynamometer maximally and exhale while squeezing
7. Each hand will be measured twice, but alternate hands after each test

Appendix H – Playground Enjoyment Questionnaire

Playground Enjoyment Survey

1 – In the **last 7 days,** during your **PHYSICAL EDUCATION (PE) CLASSES,** how often were you **very active** (playing hard, running, jumping, and throwing)? Check only one

- I don't do PE
- Hardly Ever
- Sometimes
- Quite Often
- Always

2 – In the **last 7 days,** what did you do most of the time at **RECESS?** Check only one

- Sat down (talking, reading, doing school work)
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

3 – In the **last 7 days,** what did you normally do **AT LUNCH** (besides eating lunch)? Check only one

- Sat down (talking, reading, doing school work)
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4 – In the **last 7 days,** on how many days **RIGHT AFTER SCHOOL,** did you do sports, dance, or play games in which you were very active? Check only one

- None
- 1-time last week
- 2- or 3-times last week
- 4 times last week
- 5 times last week

5 – In the **last 7 days,** on how many **EVENINGS** did you do sports, dance, or play games in which you were very active? Check only one

- None
- 1-time last week
- 2 – 3 times last week
- 4 – 5 times last week
- 6 – 7 times last week

6 – How many times did you do sports, dance, or play games in which you were very active **LAST WEEKEND?** Check only one

- None
- 1 time
- 2 – 3 times
- 4 – 5 times
- 6 or more times

7a – Where is your **MOST FAVOURITE AREA** to play? (Select one from chart)

- Area: _____

7b – Why is this your **MOST FAVOURITE AREA** to play?

- _____
  _____
  _____
  _____

8a – Where is your **LEAST FAVOURITE AREA** to play (Select one from chart)

- Area: _____

8b – Why is this your **LEAST FAVOURITE AREA TO PLAY?**

- _____
  _____
  _____
  _____

9a – **What did you do** at Afternoon Recess (1:45-2:00) today or yesterday?

- _____
  _____
  _____
  _____
- **Who did you spend** Afternoon Recess (1:45-2:00) with today or yesterday?
  - _____
    _____
- **Where did you go** during Afternoon Recess (1:45-2:00) today or yesterday?
  - _____
    _____
  - **What did you do there** during Afternoon Recess (1:45-2:00) today or yesterday?
    - _____
      _____

9b – **What did you do** at Lunch Recess (11:14-11:54) today or yesterday?

- _____
  _____
  _____
  _____
- **Who did you spend** Lunch Recess (11:14-11:54) with today or yesterday?
  - _____
    _____
- **Where did you go** during Lunch Recess (11:14-11:54) today or yesterday?
  - _____
    _____
  - **What did you do there** during Lunch Recess (11:14-11:54) today or yesterday?
    - _____
      _____

10 – Can you tell us if you **play in these areas** (Refer to chart)

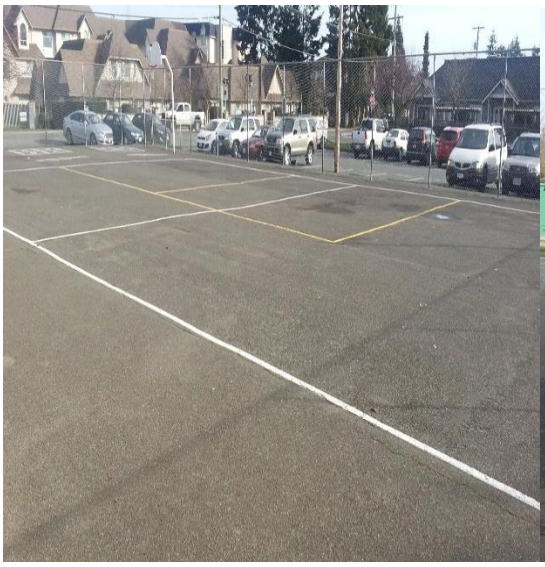
Area	How often do you play here (1-5)? 1 = not at all 2 = not much 3 = once in awhile 4 = sometimes 5 = almost always	What activities do you like doing (List activities)	What do you normally do (1-5)? 1 = Sat down (talking, reading, doing school work) 2 = Stood around or walked around 3 = Ran or played a little bit 4 = Ran around and played quite a bit 5 = Ran and played hard most of the time	How much do you like playing here?  Very Much Sometimes Once in Awhile Not Really Not at All
1	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
2	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
3	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
4	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
5	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
6	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All
7	1 2 3 4 5		1 2 3 4 5	 Very Much Sometimes Once in Awhile Not Really Not at All

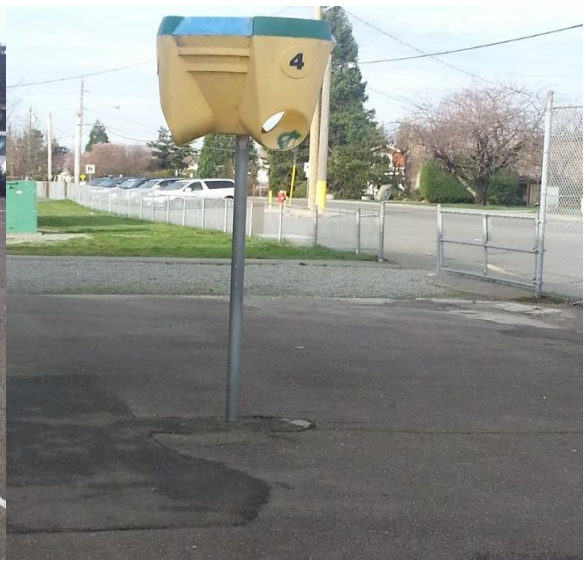
8	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
9	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
10	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
11	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
12	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
13	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**
14	1 2 3 4 5		1 2 3 4 5	 **Very Much** **Sometimes** **Once in Awhile** **Not Really** **Not at All**

PLAYGROUND CHART

Images of Each Area

Area 1





Area 2

Area 3

Area 4

Area 5

Area 6


Area 7


Area 8

Area 9

Area 10

Area 11

Area 12

Area 13






Area 14

Appendix I – Playground Enjoyment Questionnaire Play Space Categorization

Playground Enjoyment Questionnaire (PEQ) Area Categorization

Number	Area Type	Playground Enjoyment Questionnaire Areas
1	Field Spaces	8, 11
2	Built Structures	4,6, 7, 12, 14
3	Courts	1
4	Tarmac Spaces	2, 3, 9, 10
5	Nature Spaces	5, 13

Appendix J – Children's Assessment of Participant and Enjoyment Questionnaire

CAPE
Children's Assessment of Participation and Enjoyment

Activity Type Scores

Child's name _____

Age _____ ☐ Male ☐ Female Date _____

Directions: The 55 CAPE items are categorized by the five Activity Types. To calculate the CAPE Activity Type Scores, you will need to refer to the completed CAPE Summary Score Sheet for Overall Scores. Locate each CAPE item number in one of the Activity Type categories and transfer the child's response. Follow the scoring directions to calculate the child's CAPE Activity Type Scores.

Recreational Activities

CAPE Item Number	Item Description	0 No 1 Yes Diversity	1 time in past 4 months 2 times in past 4 months 3 1 time a month 4 2–3 times a month 5 1 time a week 6 2–3 times a week 7 1 time a day or more Intensity	1 Alone 2 With family 3 With other relatives 4 With friends 5 With others With Whom	1 Home 2 Relative's home 3 In your neighborhood 4 At school (but not during classes) 5 In your community 6 Beyond your community Where	1 Not at all 2 Somewhat; sort of 3 Pretty much 4 Very much 5 Love it Enjoyment
1	Doing puzzles					
2	Playing board or card games					
3	Doing crafts, drawing or coloring					
4	Collecting things					
5	Playing computer or video games					
12	Playing with pets					
14	Doing pretend or imaginary play					
15	Playing with things or toys					
32	Going for a walk or a hike					
36	Playing on equipment					
44	Watching TV or a rented movie					
55	Taking care of a pet					
	Recreational Activities Sums		÷ 12	÷ Recreational Diversity Score	÷ Recreational Diversity Score	÷ Recreational Diversity Score
			Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Recreational Activities Scores	Write sum in box below **Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Child's name _____ Date _____

Physical Activities

CAPE Item Number	Item Description	0 No, 1 Yes **Diversity**	1 time in past 4 months, 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more **Intensity**	1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others **With Whom**	1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but **not** during classes), 5 In your community, 6 Beyond your community **Where**	1 Not at all, 2 Somewhat; sort of, 3 Pretty much, 4 Very much, 5 Love it **Enjoyment**
18	Doing martial arts					
20	Racing or track and field					
21	Doing team sports					
30	Participating in school clubs					
33	Bicycling, in-line skating, or skateboarding					
34	Doing water sports					
35	Doing snow sports					
37	Playing games					
38	Gardening					
39	Fishing					
40	Doing individual physical activities					
41	Playing non-team sports					
51	Doing a paid job					
	Physical Activities Sums		÷ 13	÷ Physical Diversity Score	÷ Physical Diversity Score	÷ Physical Diversity Score
		Write sum in box below	Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Physical Activities Scores	**Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Child's name _____ Date _____

Social Activities

CAPE Item Number	Item Description	0 No, 1 Yes **Diversity**	1 1 time in past 4 months, 2 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more **Intensity**	1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others **With Whom**	1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but not during classes), 5 In your community, 6 Beyond your community **Where**	1 Not at all, 2 Somewhat; sort of, 3 Pretty much, 4 Very much, 5 Love it! **Enjoyment**
6	Talking on the phone					
7	Going to a party					
8	Hanging out					
9	Visiting					
11	Entertaining others					
42	Going to the movies					
45	Going to a live event					
46	Going on a full-day outing					
48	Listening to music					
52	Making food					
	Social Activities Sums		÷ 10	÷ Social Diversity Score	÷ Social Diversity Score	÷ Social Diversity Score
		Write sum in box below	Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Social Activities Scores	**Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Child's name _____ Date _____

Skill-Based Activities

CAPE Item Number	Item Description	0 No, 1 Yes **Diversity**	1 1 time in past 4 months, 2 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more **Intensity**	1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others **With Whom**	1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but **not** during classes), 5 In your community, 6 Beyond your community **Where**	1 Not at all, 2 Somewhat; sort of, 3 Pretty much, 4 Very much, 5 Love it **Enjoyment**
17	Swimming					
18	Doing gymnastics					
19	Horseback riding					
22	Learning to sing (choir or individual lessons)					
23	Taking art lessons					
24	Learning to dance					
26	Playing a musical instrument					
27	Taking music lessons					
28	Participating in community organizations					
31	Dancing					
	Skill-Based Activities Sums		÷ 10	÷ Skill-Based Diversity Score	÷ Skill-Based Diversity Score	÷ Skill-Based Diversity Score
			Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Skill-Based Activities Scores	**Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Child's name _____ Date _____

Self-Improvement Activities

CAPE Item Number	Item Description	Diversity (0 No, 1 Yes)	Intensity (1 1 time in past 4 months, 2 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more)	With Whom (1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others)	Where (1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but not during classes), 5 In your community, 6 Beyond your community)	Enjoyment (1 Not at all, 2 Somewhat; sort of, 3 Pretty much, 4 Very much, 5 Love it)
10	Writing letters					
13	Writing a story					
25	Getting extra help for schoolwork from a tutor					
29	Doing a religious activity					
43	Going to the public library					
47	Reading					
49	Doing volunteer work					
50	Doing a chore					
53	Doing homework					
54	Shopping					
	Self-Improvement Activities Sums		÷ 10	÷ Self-Improvement Diversity Score	÷ Self-Improvement Diversity Score	÷ Self-Improvement Diversity Score
		Write sum in box below	Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Self-Improvement Activities Scores	**Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Informal Domain

CAPE Item Number	Item Description	Diversity (0 No, 1 Yes)	Intensity (1 1 time in past 4 months, 2 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more)	With Whom (1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others)	Where (1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but not during classes), 5 In your community, 6 Beyond your community)	Enjoyment (1 Not at all, 2 Somewhat, sort of, 3 Pretty much, 4 Very much, 5 Love it)
1	Doing puzzles					
2	Playing board or card games					
3	Doing crafts, drawing or coloring					
4	Collecting things					
5	Playing computer or video games					
6	Talking on the phone					
7	Going to a party					
8	Hanging out					
9	Visiting					
10	Writing letters					
11	Entertaining others					
12	Playing with pets					
13	Writing a story					
14	Doing pretend or imaginary play					
15	Playing with things or toys					
31	Dancing					
32	Going for a walk or a bike					
33	Bicycling, in-line skating, or skateboarding					
34	Doing water sports					
35	Doing snow sports					
36	Playing on equipment					
37	Playing games					
38	Gardening					
39	Fishing					
40	Doing individual physical activities					
	Subtotals for each dimension Transfer these subtotals to the calculation section.	**Diversity**	**Intensity**	**With Whom**	**Where**	**Enjoyment**

Informal Domain (continued)

CAPE Item Number	Item Description	Diversity (0 No, 1 Yes)	Intensity (1 1 time in past 4 months, 2 2 times in past 4 months, 3 1 time a month, 4 2–3 times a month, 5 1 time a week, 6 2–3 times a week, 7 1 time a day or more)	With Whom (1 Alone, 2 With family, 3 With other relatives, 4 With friends, 5 With others)	Where (1 Home, 2 Relative's home, 3 In your neighborhood, 4 At school (but not during classes), 5 In your community, 6 Beyond your community)	Enjoyment (1 Not at all, 2 Somewhat, sort of, 3 Pretty much, 4 Very much, 5 Love it)
41	Playing non-team sports					
42	Going to the movies					
43	Going to the public library					
44	Watching TV or a rented movie					
45	Going to a live event					
46	Going on a full-day outing					
47	Reading					
48	Listening to music					
49	Doing volunteer work					
50	Doing a chore					
51	Doing a paid job					
52	Making food					
53	Doing homework					
54	Shopping					
55	Taking care of a pet					
	Subtotals for each dimension Transfer these subtotals to the calculation section below.	**Diversity**	**Intensity**	**With Whom**	**Where**	**Enjoyment**

Scoring Calculations

Follow the directions provided in each column to calculate the Informal Domain Score for each dimension.

	Diversity	Intensity	With Whom	Where	Enjoyment
Informal Domain Sums	Subtotal for Items Page 1 + Subtotal for Items Page 2 =	Subtotal for Items Page 1 + Subtotal for Items Page 2 = ÷ 40	Subtotal for Items Page 1 + Subtotal for Items Page 2 = ÷ Informal Diversity Score	Subtotal for Items Page 1 + Subtotal for Items Page 2 = ÷ Informal Diversity Score	Subtotal for Items Page 1 + Subtotal for Items Page 2 = ÷ Informal Diversity Score
Informal Domain Scores	Write sum in box below	Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Diversity Score	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Child's name _____ Date _____

Formal Domain

CAPE Item Number	Item Description	0 No 1 Yes **Diversity**	1 1 time in past 4 months 2 2 times in past 4 months 3 1 time a month 4 2–3 times a month 5 1 time a week 6 2–3 times a week 7 1 time a day or more **Intensity**	1 Alone 2 With family 3 With other relatives 4 With friends 5 With others **With Whom**	1 Home 2 Relative's home 3 In your neighborhood 4 At school (but **not** during classes) 5 In your community 6 Beyond your community **Where**	1 Not at all 2 Somewhat, sort of 3 Pretty much 4 Very much 5 Love it **Enjoyment**
16	Doing martial arts					
17	Swimming					
18	Doing gymnastics					
19	Horseback riding					
20	Racing or track and field					
21	Doing team sports					
22	Learning to sing (choir or individual lessons)					
23	Taking art lessons					
24	Learning to dance					
25	Getting extra help for schoolwork from a tutor					
26	Playing a musical instrument					
27	Taking music lessons					
28	Participating in community organizations					
29	Doing a religious activity					
30	Participating in school clubs					
	Totals for each dimension Follow the directions provided in each column to calculate the Formal Domain Score for each dimension.	**Diversity**	**Intensity**	**With Whom**	**Where**	**Enjoyment**
	Formal Domain Sums		÷ 15	÷ Formal Diversity Score	÷ Formal Diversity Score	÷ Formal Diversity Score
		Write sum in box below	Write total in box below	Write total in box below	Write total in box below	Write total in box below
	Formal Domain Scores	**Diversity Score**	**Intensity Score**	**With Whom Score**	**Where Score**	**Enjoyment Score**

Appendix K – Correlation Table for Variables Associated with Field Spaces

Correlation Table of variables associated to frequency, intensity, enjoyment, and activity type on field spaces

	Frequency	Intensity	Enjoyment	Activity
Stork Stand	.000 (.999)	.047 (.738)	.095 (.494)	.231 (.093)
Grip Strength	.208 (.131)	.296 (.030)*	.398 (.003)**	.263 (.055)
Recreational PA	.128 (.358)	.201 (.145)	.055 (.691)	.104 (.452)
Locomotor Score	.096 (.492)	.201 (.145)	.207 (.134)	.020 (.887)
Object Control Score	.017 (.900)	.057 (.683)	.099 (.477)	.080 (.563)
Gross Motor Quotient	.071 (.611)	.160 (.248)	.187 (.177)	.057 (.683)
PAQ-C	.242 (.078)	.437 (.001)**	.273 (.046)*	.237 (.085)

Note. () refers to r value, * refers to significant $p < .05$, ** refers to significant $p < .001$

Appendix L – Correlation Table for Variables Associated with Built Structures

Correlation Table of variables associated to frequency, intensity, enjoyment, and activity type on built structures

	Frequency	Intensity	Enjoyment	Activity
Stork Stand	.000 (.997)	.092 (.509)	.067 (.628)	.086 (.534)
Grip Strength	.160 (.248)	.254 (.064)	.166 (.230)	.137 (.322)
Recreational PA	.122 (.381)	.206 (.135)	.137 (.322)	-.082 (.556)
Locomotor Score	.072 (.604)	.191 (.167)	.090 (.515)	.058 (.674)
Object Control Score	-.211 (.125)	-.108 (.438)	-.160 (.247)	-.175 (.205)
Gross Motor Quotient	-.069 (.618)	.063 (.648)	-.030 (.830)	-.134 (.336)
PA Level	.272 (.046)*	.396 (.003)**	.235 (.088)	.028 (.843)

Note. () refers to r value, * refers to significant $p < .05$, ** refers to significant $p < .001$

Appendix M – Correlation Table for Variables Associated with Courts

Correlation Table of variables associated to frequency, intensity, enjoyment, and activity type on courts

	Frequency	Intensity	Enjoyment	Activity
Stork Stand	.179 (.196)	.208 (.132)	.173 (.210)	.009 (.947)
Grip Strength	.118 (.397)	.259 (.058)	.328 (.016)*	.067 (.630)
Recreational PA	.005 (.970)	.059 (.672)	.111 (.423)	-.015 (.912)
Locomotor Score	.027 (.848)	.237 (.084)	.144 (.300)	.103 (.457)
Object Control Score	.263 (.055)	.222 (.107)	.096 (.488)	.169 (.223)
Gross Motor Quotient	.161 (.245)	.273 (.045)*	.145 (.296)	.159 (.252)
PA Level	.310 (.023)*	.435 (.001)**	.437 (.001)**	-.079 (.569)

Note. () refers to r value, * refers to significant $p < .05$, ** refers to significant $p < .001$

Appendix N – Correlation Table for Variables Associated with Tarmac Spaces

Correlation Table of variables associated to frequency, intensity, enjoyment, and activity type on tarmac spaces

	Frequency	Intensity	Enjoyment	Activity
Stork Stand	.001 (.997)	.033 (.812)	-.005 (.972)	-.004 (.977)
Grip Strength	-.183 (.185)	-.064 (.648)	-.093 (.504)	.054 (.968)
Recreational PA	-.326 (.016)*	-.194 (.160)	-.261 (.057)	-.248 (.071)
Locomotor Score	.106 (.445)	.157 (.258)	.141 (.308)	.173 (.210)
Object Control Score	.042 (.764)	.137 (.324)	.021 (.878)	.190 (.169)
Gross Motor Quotient	.091 (.513)	.175 (.205)	.102 (.462)	.215 (.118)
PA Level	.022 (.872)	.269 (.049)*	.012 (.933)	-.109 (.431)

Note. () refers to r value, * refers to significant $p < .05$

Appendix O – Correlation Table for Variables Associated with Nature Spaces

Correlation Table of variables associated to frequency, intensity, enjoyment, and activity type on nature spaces

	Frequency	Intensity	Enjoyment	Activity
Stork Stand	-.077 (.579)	-.011 (.936)	.021 (.877)	.038 (.788)
Grip Strength	-.045 (.749)	-.007 (.960)	.025 (.858)	.045 (.744)
Recreational PA	-.008 (.952)	.065 (.639)	.090 (.515)	.023 (.872)
Locomotor Score	-.089 (.520)	.002 (.988)	-.042 (.765)	.104 (.453)
Object Control Score	-.178 (.199)	-.035 (.801)	-.155 (.264)	.070 (.616)
Gross Motor Quotient	-.155 (.264)	-.018 (.898)	-.111 (.423)	.105 (.449)
PA Level	-.269 (.050)*	-.001 (.993)	-.065 (.643)	-.142 (.305)

( ) = p value, * = significant $p < .05$

Appendix P Frequency of Visits to Play Spaces Based on Gross Motor Quotient

ANOVA results for Frequency of Visits to Areas based on Gross Motor Quotient

		Mean (SD)	F (df)	Sig
Field Spaces (Area 1)	High	2.79 (0.92)	.878 (1,52)	.353
	Low	2.50 (1.30)		
Built Structures (Area 2)	High	2.96 (0.96)	.323(1,52)	.573
	Low	3.12 (0.99)		
Courts (Area 3)	High	2.32 (1.19)	.142 (1,52)	.708
	Low	2.19 (1.33)		
Tarmac Spaces (Area 4)	High	2.36 (1.03)	.281 (1,52)	.598
	Low	2.50 (0.95)		
Nature Spaces (Area 5)	High	2.04 (0.88)	1.235 (1,52)	.272
	Low	2.38 (1.39)		

Note. SD refers to standard deviation

Appendix Q Activity Type in each Play Space Based on Gross Motor Quotient

ANOVA results for differences in Reported Activity Type by Gross Motor Quotient

		Mean (SD)	F (df)	Sig
Field Spaces (Area 1)	High	2.29 (1.36)	.002 (1,52)	.961
	Low	2.31 (1.91)		
Built Structures (Area 2)	High	2.07 (0.81)	1.108 (1,52)	.297
	Low	2.35 (1.09)		
Courts (Area 3)	High	2.21 (1.69)	.172 (1,52)	.680
	Low	2.00 (2.10)		
Tarmac Spaces (Area 4)	High	2.32 (1.49)	.696 (1,52)	.408
	Low	2.00 (1.33)		
Nature Spaces (Area 5)	High	1.89 (1.62)	.080 (1,52)	.778
	Low	1.77 (1.58)		

Note. SD refers to standard deviation

Appendix R – Intensity in each Play Space Based on Gross Motor Quotient

ANOVA results for Intensity based on Gross Motor Quotient

		Mean (SD)	F (df)	Sig
Field Spaces (Area 1)	High	3.00 (1.49)	1.079 (1,52)	.304
	Low	2.58 (1.50)		
Built Structures (Area 2)	High	3.18 (1.33)	.272 (1,52)	.604
	Low	3.00 (1.17)		
Courts (Area 3)	High	2.89 (1.95)	2.286 (1,52)	.137
	Low	2.12 (1.82)		
Tarmac Spaces (Area 4)	High	2.29 (1.46)	.131 (1,52)	.719
	Low	2.15 (1.19)		
Nature Spaces (Area 5)	High	1.93 (1.49)	.179 (1,52)	.674
	Low	2.12 (1.75)		

Note. SD refers to standard deviation

Appendix S – Enjoyment of Play Spaces Based on Gross Motor Quotient

ANOVA results for Enjoyment based on Gross Motor Quotient

		Mean (SD)	F (df)	Sig
Field Spaces (Area 1)	High	2.60 (1.07)	1.706 (1,52)	.197
	Low	2.19 (1.27)		
Built Structures (Area 2)	High	2.61 (1.07)	.001 (1,52)	.977
	Low	2.62 (0.98)		
Courts (Area 3)	High	2.00 (1.36)	.315 (1,52)	.577
	Low	1.77 (1.66)		
Tarmac Spaces (Area 4)	High	1.93 (1.15)	.021 (1,52)	.885
	Low	1.88 (1.07)		
Nature Spaces (Area 5)	High	1.75 (1.21)	1.090 (1,52)	.301
	Low	2.12 (1.37)		

Note. SD refers to standard deviation

Appendix T – Regression Analysis Field Spaces

Regression Analysis for Frequency, Intensity, Type, and Enjoyment of Field Spaces

		B	SE B	β	Sig
Frequency					
	Sex	-.675	.296	-.301	.027
Intensity					
	Object Control	-.096	.103	-.131	.358
	Locomotor	.098	.092	.157	.291
	Grip Strength	.041	.070	.091	.558
	PA Level	.116	.041	.403	.007
Enjoyment					
	Sex	-.348	.318	-.148	.280
	Grip Strength	.106	.052	.301	.048
	PA Level	.024	.032	.108	.454
Activities					
	Object Control	.080	.191	.101	.675
	Gross Motor Quotient	-.004	.035	-.025	.917

Appendix U – Regression Analysis Built Structures

Regression Analysis for Frequency, Intensity, Type, and Enjoyment of Built Structures

		B	SE B	β	Sig
Frequency					
	PA Level	.062	.025	.331	.016
	Object Control	-.170	.068	-.359	.016
	Locomotor	.069	.057	.171	.231
Intensity					
	PA Level	.103	.030	.431	.001
	Object Control	-.192	.083	-.314	.026
	Locomotor	.134	.070	.256	.062
Enjoyment					
	Gross Motor Quotient	.027	.021	.294	.213
	Object Control	-.199	.116	-.399	.093
Activities					
	Gross Motor Quotient	.002	.020	.026	.109
	Object Control	-.092	.111	-.196	.409

Appendix V – Regression Analysis Court Spaces

Regression Analysis for Frequency, Intensity, Type, and Enjoyment of Courts

		B	SE B	β	Sig
Frequency					
	PA Level	.074	.032	.310	.023
Intensity					
	PA Level	.144	.046	.393	.003
	Gross Motor Quotient	.032	.022	.186	.149
Enjoyment					
	PA Level	.100	.039	.347	.014
	Sex	-.714	.388	-.238	.071
	Grip Strength	.042	.064	.092	.517
Activities					
	Object Control	.107	.217	.117	.623
	Gross Motor Quotient	.011	.040	.06	787

Appendix W – Regression Analysis Tarmac Spaces

Regression Analysis for Frequency, Intensity, Type, and Enjoyment of Tarmac Areas

		B	SE B	β	Sig
Frequency					
	Object Control	-.058	.109	-.120	.601
	Gross Motor Quotient	.017	.020	.192	.403
	Recreational PA	-.132	.053	-.330	.016
Intensity					
	Locomotor	.058	.082	.105	.483
	Object Control	.024	.098	.036	.811
	PA Level				
Enjoyment					
	Object Control	-.098	.128	-.181	.450
	Gross Motor Quotient	.025	.023	.249	.299
Activities					
	Object Control	.031	.162	.045	.849
	Gross Motor Quotient	.023	.029	.179	.448

Appendix X – Regression Analysis Nature Areas

Regression Analysis for Frequency, Intensity, Type, and Enjoyment of Nature Areas

		B	SE B	β	Sig
Frequency					
	Locomotor	-.002	.072	-.004	.976
	Object Control	-.068	.085	-.120	.432
	PA Level	-.053	.031	.240	.091
Intensity					
	Object Control	-.048	.188	-.060	.802
	Gross Motor Quotient	.004	.034	.031	.897
Enjoyment					
	Locomotor	.048	.081	.088	.559
	Object Control	-.109	.093	-.173	.245
	Sex	-.723	.354	-.281	.046
Activities					
	Object Control	-.035	.185	-.045	.849
	Gross Motor Quotient	.020	.034	.142	.554