An Examination of Physical Activity and Motor Competence in Parents and Children

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Kinesiology)
in the University of Michigan
2021

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Acknowledgments

I am extremely grateful for the continuous support and guidance I received from my mentors, colleagues, friends, and family during my PhD journey. My path to a PhD began when I was working at Beauvoir: The National Cathedral Elementary School when I realized that I wanted to combine my two passions of working with children and physical activity. While finishing up my master's at the University of Texas at Austin I was provided with the opportunity to conduct research under Dr. Leah Robinson at the University of Michigan, which sparked my interests in community health and the importance of connecting research and industry. I would like to acknowledge those who have had the greatest impact on my research, the success of this dissertation study, and supported me to get a PhD.

- Dr. Leah Robinson- Thank you for being an inspiring mentor and guide over the last four years. You pushed me to work my hardest, develop my own research agenda, and learn to navigate the ropes of academia. Thank you for the guidance, support, and endless edits and revisions—especially throughout the pandemic. Your passion for research and career of becoming a Professor at University of Michigan demonstrated how hard work and perseverance are the keys to success. Thank you for also teaching me how bubbly can solve any problem!
- Carissa Wengrovius, Kara Palmer, Sarah Rock and the whole CMAH Lab- I would be nowhere without all of you and the lab- I have learned how to conduct research, analyze results, and developed a passion for physical activity and motor competence. Carissa, I could not have done this without you-truly! Having a colleague and friend to navigate this PhD was what got me through---from countless hours analyzing results, taking classes

together, PhD timelines and requirements, and numerous happy hours—you were a lifesaver. Kara, your dedication, hard work, and expertise have been the absolute biggest help. Thank you for leading the way in the lab. You were always willing to support me and provide advice that was extremely helpful. To Sarah Rock and the CMAH lab thank you for your help with my dissertation study as it was converted from in-person to online.

- My Doctoral Committee- Thank you for being my guidance, support, and cheering me on throughout the past four years. I appreciate all the advice and expertise that helped shape my original proposal and then conversion to the online format. Thank you for investing in me as I navigated through this.
- Andrew Scott, my husband- You moved to Michigan with no question and have supported me every single day. There have been many ups and downs and I am so lucky to have you. Thank you for being my cheerleader and letting me be a dreamer as I pursed my PhD.
- Mom, Dad, Sarah, and my entire family- Thank you, thank you for me pushing me to get a PhD, helping me conceptualize my study, editing research papers, and for always believing in me. As Andrew and I basically lived at Keswick for most of COVID your continuous support, runs and walks with Rosie, endless meals, and countless quarantine adventures helped get me to the finish line.

Lastly, I would like to thank the parents and children involved in this dissertation study! Thank you for working with me amidst a global pandemic.

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Abstract

Both parents' and children's physical activity levels are extremely low in the United States, with documented adverse consequences on physical and mental health status. One potential contributing factor to low physical activity is low motor competence. Motor competence is important to consider due to its established association with physical activity. Motor competence provides the foundation for movement and play; this skill needs to be learned, practiced, and reinforced. Perceived competence refers to one's self-perceptions of their actual abilities and is associated with motor competence and physical activity. The home environment offers an ideal setting to target low physical activity levels in parents and children, but few studies have examined parents' associations and determinants. Before developing interventions, parents' associations and determinants of physical activity and motor competence warrant further investigation. A mixed methods approach was adopted in this dissertation study to explore associations of and beliefs about physical activity, motor competence, and perceived competence in parents and children. A secondary purpose of this study was to examine the impact of COVID-19 on physical activity, as this study was converted from an in-person to online format amid the pandemic. Anthropometric data and perceived competence assessments were completed online; motor skill assessments were performed, filmed, and uploaded by parent-child dyads; physical activity was assessed using accelerometers mailed directly to parent-child dyads' homes; and interviews were conducted through Zoom.

Aim 1 examined the associations of physical activity, motor competence, and perceived competence in parents and children. No significant association was observed between these three

variables among either parents or children. For children, these findings do not support widely accepted conceptual models in motor development; this discrepancy may be attributed to the adopted measures of motor competence and perceived competence as well as this study's online format. Limited research has examined parents' motor competence.

Aims 2 and 3 explored the associations between physical activity, motor competence, and perceived competence in parent-child dyads. Physical activity and motor competence were significantly associated. Parents thus played key roles in supporting physical activity and motor competence in their children, highlighting the importance of parent determinants on children's health behaviors.

Aim 4 documented and described beliefs about physical activity and motor competence through semi-structured interviews and the triangulation of all data sources. Seven themes were derived from interviews: knowledge, perceptions, engagement, benefits, barriers, motivators, and COVID-19. Interviews indicated that parents had accurate knowledge about physical activity and motor competence whereas children did not. Parents and children both held positive perceptions, identified benefits and barriers, and engaged in physical activity. Parents were motivated to be active because of their children, whereas children were motivated by social factors. COVID-19 negatively influenced physical activity. Triangulation revealed that parents had accurate knowledge but inaccurate perceptions about their children's physical activity and motor competence. Children overestimated their physical activity on questionnaires but described it accurately during interviews. Regarding COVID-19, parents reported spending more hours with their children, but no differences emerged in self-reported physical activity.

Together, the results of this dissertation study suggest that family health interventions are crucial given parents' influences on their children's physical activity and motor competence. Parents and children seem to possess positive perceptions about physical activity and motor competence yet need external motivators and opportunities to engage in such activities. Additionally, COVID-19 appears to have negatively affected parents and children.

Chapter I Introduction

Being physically active is critical for humans: humans are born to move their bodies, and physical activity is an effective way to promote overall health. The relevant literature has established positive and favorable associations between physical activity and numerous health indicators in children and adults. These factors include cardiorespiratory and muscular fitness, bone health, cognitive function, weight status, reductions in cardiovascular risk factors, and reductions in other non-communicable diseases (Poitras et al., 2016; Reiner et al., 2013; United States Department of Health and Human Services, 2018). Despite direct health benefits, children and adults do not currently meet physical activity guidelines. Only 42% of children between 6 and 11 years old meet the physical activity guideline of accumulating 60 minutes of moderate to vigorous physical activity (MVPA) each day (Troiano et al., 2008). Merely 11% of adults meet the guideline of obtaining 150 minutes of MVPA or 75 minutes of vigorous physical activity (VPA) per week (Tucker et al., 2011). Recent surveillance data further confirmed low levels of physical activity in adults (Althoff et al., 2017). Physical inactivity adversely affects an individual's morbidity and mortality and costs the United States billions of dollars each year in health care (Carlson et al., 2015).

Motor Competence

Motor skills are defined as goal-specific actions that require voluntary behavior (Payne & Isaacs, 2017). Motor development research has focused extensively on fundamental motor skills (FMS), which represent one component of motor skills (Logan et al., 2018). FMS refer to basic learned movement patterns or "building blocks" that do not occur naturally and are foundational to more complex movements, sports, and physical activities (Gallahue et al., 2012). FMS include locomotor skills (e.g., run, hop), object manipulation/ball skills (e.g., kick, throw), and stability skills (e.g., balance) (Gallahue et al., 2012). Motor competence involves one's proficiency in a range of motor skills, including FMS. Motor competence has been deemed a potential contributing factor to physical activity. A hypothetical "proficiency barrier" to motor competence is thought to influence one's ability to successfully participate in physical activity (Stodden et al., 2008). If children do not develop motor competence, they will presumably fall into a spiral of disengagement and not participate in optimal levels of physical activity throughout their life (Stodden et al., 2008). Concerningly, children in the United States consistently exhibit low motor competence and FMS competence (Brian et al., 2018, 2019; Goodway et al., 2010; O' Brien et al., 2016). Motor competence and FMS competence in adults remain underexplored.

Motor competence is essential in human movement and must be considered when conducting physical activity research and developing related interventions. In children and adolescents, motor competence is positively associated with physical activity (Holfelder & Schott, 2014; Logan et al., 2015; Lubans et al., 2010), health-related fitness (i.e., cardiorespiratory fitness and musculoskeletal health) (Cattuzzo et al., 2016; Robinson et al., 2015a), weight status (Cattuzzo et al., 2016; Lubans et al., 2010), academic performance and cognitive development (Haapala, 2013), and perceived competence (Robinson et al., 2015a). Perceived competence refers to one's self-perceptions of their abilities, a key aspect of perceived motor competence (i.e., a person's self-perception of their current level of motor competence) (Harter, 1999; Robinson et al., 2011). Perceived competence is important to consider in motor competence research. In children and adolescents, perceived competence is significantly associated with motor competence (De Meester et al., 2016, 2018, 2020) and physical activity (Babic et al., 2014; De Meester et al., 2016, 2018).

Perceived competence appears to also mediate the association between motor competence and physical activity (Barnett et al., 2008, 2011; Khodaverdi et al., 2015).

Compared to studies involving children, scarce research has examined adults' motor competence, including FMS. This knowledge gap is inherently problematic; if children and adolescents are not developing motor competence, then adults' motor competence is likely low as a result. Motor competence could negatively affect adult populations' physical activity levels and other health outcomes. To date, only four studies to date have explored motor competence concerning positive health outcomes in adults (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009). Adult motor competence appears associated with perceived competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019), body mass index (BMI) (Cantell et al., 2008; Sackett & Edwards, 2019), and physical fitness in adults (Cantell et al., 2008; Sackett & Edwards, 2019; Stodden et al., 2009). A pair of studies on motor competence and physical activity found no evidence of an association between these two factors (Cantell et al., 2008; Sackett & Edwards, 2019). However, both studies relied on self-report measures of physical activity, demonstrating the need for research using objective measurements. In adults, perceived competence is also an important factor to consider as it has been found to be associated with motor competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019) and physical activity (Sackett & Edwards, 2019). Motor competence and perceived competence play a critical role in health outcomes, including physical activity, in children and adolescents. A similar relationship may exist in adults.

Increasing Physical Activity and Motor Competence

The federal government's physical activity guidelines (i.e., 60 minutes of MVPA per day for children and 150 minutes of MVPA or 75 minutes of VPA per week for adults) are meant to serve as the primary source of evidence-based guidance on physical activity, fitness, and health for

Americans (United States Department of Health and Human Services, 2018). Because most Americans continue to fall short of these guidelines, research and practice efforts over the past several decades have focused on determining effective strategies to increase and maintain optimal levels of physical activity in children and adults. Numerous government organizations and campaigns have emerged as researchers continue to develop evidence-based interventions (United States Department of Health and Human Services, 2018). Motor competence and motor skills are not explicitly discussed in the present physical activity guidelines. Although different government organizations and campaigns have acknowledged motor competence and FMS development as necessary, these factors have yet to be fully incorporated into physical activity interventions. Meanwhile, it remains challenging to understand why people are inactive and to encourage greater physical activity (Reis et al., 2016) and motor competence.

Social Ecological Model

Behavior change research and strategies emphasize the importance of social ecological approaches to understand and intervene on determinants of health behaviors (Hayden, 2014). Social ecological approaches consider factors at the individual, interpersonal, organizational, community, and policy levels. This multi-level model further recognizes that factors at different levels are interdependent and work together to determine an individual's health behaviors (i.e., whether to engage in a health behavior or not). The social ecological approach is especially pertinent to physical activity, which is a multi-dimensional behavior. Given this complexity, physical activity research and interventions must use multi-component, evidence-based approaches (Müller et al., 2005). The Centers for Disease Control and Prevention (CDC) and Society of Health and Physical Educators (SHAPE) of America have endorsed a social ecological framework, the Comprehensive School and Physical Activity Program (CSPAP). This framework is intended to increase children's physical activity within the school community by promoting such activity through physical education; physical activity before, during, and after school; staff involvement; and family and community engagement. Within this framework, parents serve as a key determinant of children's health behaviors, including physical activity and motor competence (Brown et al., 2016; Hutchens & Lee, 2018; Yao & Rhodes, 2015). The current study recognizes the importance of a social ecological approach; however, due to limited research examining associations between parent-child dyads and parent determinants of physical and motor competence, this dissertation study focuses solely on interpersonal and intrapersonal determinants.

Parent Determinants of Physical Activity and Motor Competence

The home environment plays a vital role in children's health behaviors, including physical activity (Davison et al., 2013; Gattshall et al., 2008; Mâsse et al., 2017). The physical (i.e., availability and accessibility) and social (i.e., parenting practices and attributes) components of the home environment have both been found to predict children's physical activity significantly (Davison et al., 2013; Gattshall et al., 2008; Mâsse et al., 2017). Additionally, parents are thought to play an integral part in children's physical activity within the home environment. Parents are generally the "gatekeepers" to the home and have the most contact hours in and control of their child's lives, thus influencing their children's physical activity in various ways (Hutchens & Lee, 2018; Yao & Rhodes, 2015). Notable parent determinants (also termed "parent practices") include parental knowledge (Haddad et al., 2018), encouragement (Haddad et al., 2018; Hutchens & Lee, 2018; Xu et al., 2015), support (Garriguet et al., 2017; Hutchens & Lee, 2018; Xu et al., 2015; Yao & Rhodes, 2015), self-efficacy (Xu et al., 2015), and parents' physical activity (Garriguet et al., 2017; Hutchens & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015).

Research has shown that parents' physical activity is a significant predictor of children's physical activity. However, few studies have objectively measured both parents' and children's physical activity (Hutchens & Lee, 2018; Yao & Rhodes, 2015). Objective physical activity is a method of evaluating physical activity indirectly through various devices that measure activity counts; considered best practice in physical activity research (Vanhees et al., 2005). In a literature review by Hutchens and Lee (2018), eight of the 30 reviewed studies examined parents' and children's physical activity; however, none measured parents' and children's physical activity objectively. In Yao and Rhodes' (2015) meta-analysis, only four studies objectively measured both parents' and children's physical activity. These four studies found varying strengths of the association, from weak to strong, between parents' and children's physical activity (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011; Yao & Rhodes, 2015). These results demonstrate that the association of physical activity in parent-child dyads warrants further research using objective measurements. "Parent-child dyads" refer to the pairing of a child and primary caregiver (Health & Medicine Policy Group, 2018).

No published research has investigated the association of motor competence between parent-child dyads to the author's knowledge. A significant association similar to that identified between parents' and children's physical activity levels plausibly exists (Hutchens & Lee, 2018; Yao & Rhodes, 2015), namely a significant association between motor competence in parents and children. Research is needed to understand the complexities of low physical activity in both parties. Clarifying parent determinants of children's low physical activity levels and motor competence is likewise essential.

Beliefs about Physical Activity and Motor Competence

It is also important to examine current beliefs—specifically knowledge, perceptions, and engagement—that facilitate or inhibit physical activity and motor competence in parents and children. Further insight about knowledge, perceptions, and engagement will support research and tailor interventions to increase physical activity and motor competence. Knowledge ensures that parents and children understand what physical activity and motor competence are and can provide examples of these behaviors. Perceptions of physical activity and motor competence include one's overall viewpoints, beliefs about these factors' importance, and current ability levels. Engagement encompasses activities, involvement, and aspirations associated with physical activity and motor competence. Quantitative and qualitative studies have explored individuals' beliefs about these two concepts.

Quantitative Studies

Little research has examined knowledge about motor competence and physical activity. A recent survey of 250 parents found that 88% of respondents noted a difference between physical activity and motor skills, and 99.6% believed that motor skills were critical to supporting healthy development (Scott-Andrews et al., in review). Another study also found that parents are knowledgeable about the children's physical activity guidelines (i.e., 60 minutes a day of MVPA) (Haddad et al., 2018). Yet other studies of physical activity knowledge revealed that parents neither expressed concern about their children's inactivity (Scott-Andrews et al., 2020; Slater et al., 2010) nor knew the physical activity guidelines for children (Sawyer et al., 2014).

Research regarding perceptions has indicated that parents inaccurately perceive their children's physical activity and motor competence levels, which may influence whether parents promote health behaviors in their children. For example, parents tend to overestimate their children's physical activity (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020). In terms of motor competence, findings about parents' beliefs are mixed: Silvia et al. (2017) and Zysset et al. (2018) noted that parents overestimated young children's motor competence, whereas other studies have highlighted parents as good predictors of their children's motor competence (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015). Yet, these studies also revealed that parents need more education about motor skills to actively promote these skills in their children (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015).

The concept of engagement is best explored through qualitative studies involving parents and children. Inaccurate beliefs about motor competence and physical activity may inhibit parents and children from being active and developing motor competence.

Qualitative Studies

Qualitative studies are necessary to understand health behaviors better and to enable parents and children to discuss and reflect on their beliefs about motor competence and physical activity. However, scant qualitative research has examined beliefs about physical activity among parents and/or children (Bentley et al., 2012; Brown et al., 2015; Humbert et al., 2006; Kesten et al., 2015; Moore et al., 2010; A. Thompson et al., 2003; J. Thompson et al., 2010), and none has focused on motor competence. Thompson et al. (2010) examined knowledge about physical activity. The authors found that parents understood physical activity and considered it important to engage in such activity for themselves and their families (Thompson et al., 2010). Yet neither these parents nor their families participated in a sufficient amount of physical activity (Thompson et al., 2010). Bentley et al. (2012) and Kesten et al. (2015) scrutinized parents' perceptions about physical activity; both parents and children perceived it inaccurately, coinciding with quantitative studies (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020). Brown et al. (2015), Humbert et al. (2006), and Thompson et al. (2003) examined participation in physical activity. Brown et al. (2015) found that when developing physical activity interventions, the interventions need to be fun and engaging rather than focused on improving health or weight, as these outcomes are not immediately tangible. Humbert et al. (2006) and Moore et al. (2010) discovered that physical activity in youth and adults is affected at all levels of the social ecological model. Thompson et al. (2003) found that physical activity behaviors in childhood follow into adulthood. Taken together, these studies demonstrate a need for more qualitative research to uncover parents' and children's beliefs about physical activity and motor competence. Results can inform effective interventions. This dissertation study investigated beliefs about motor competence and physical activity using quantitative and qualitative methods. Quantitative data sources included questionnaires, physical activity data, and motor competence data; qualitative data included a home environment assessment and semi-structured interviews with parents and children.

Models and Theory

The design and development of this dissertation study was guided by models from Stodden et al. (2008) and Robinson et al. (2015a). These models are the most referenced and accepted in the field of motor development. At the heart of Stodden et al.'s (2008) model is a reciprocal and developmentally dynamic association between motor competence and physical activity (see Figure

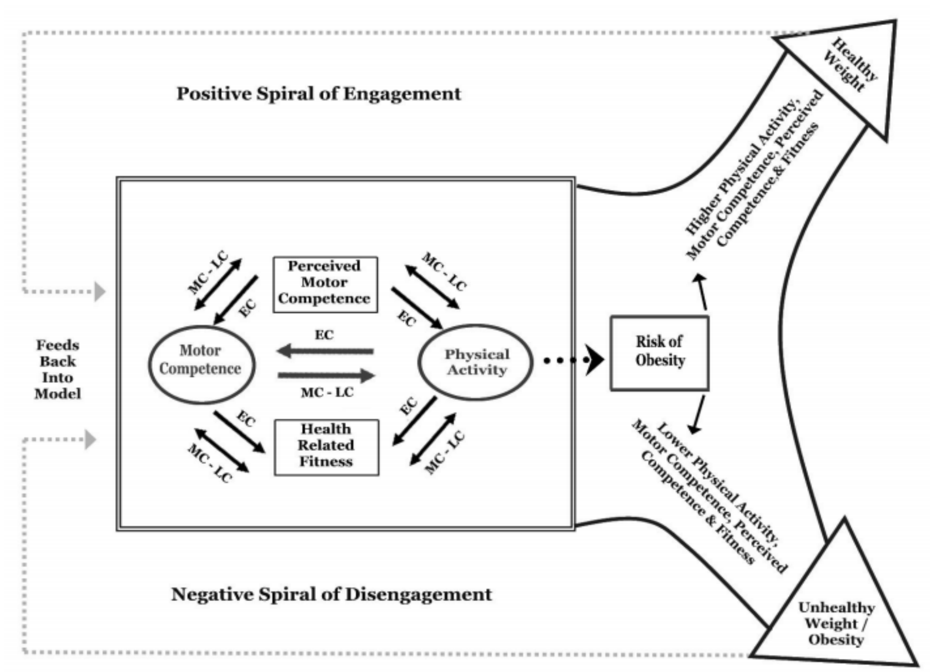


Figure I.1. Developmental model proposed by Stodden et al. (2008).

I.1). Their model proposes a bi-directional association between motor competence and physical activity, mediated by perceived motor competence, health-related fitness, and obesity. Within this model, obesity is also an outcome. In 2015, Robinson and colleagues conducted a review to

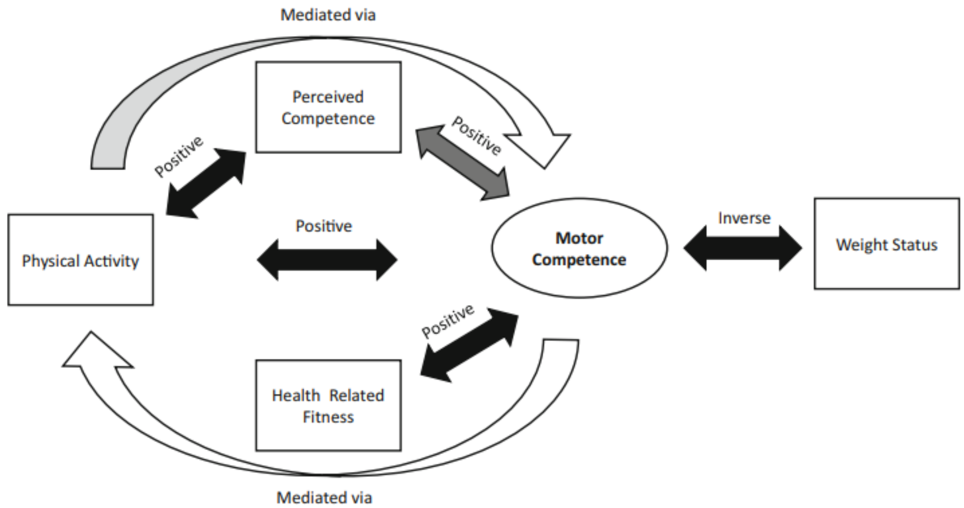


Figure I.2: Updated developmental model developed by Robinson et al. (2015a).

compile the most current research to support Stodden et al.'s (2008) model. The authors explored direct and indirect associations between physical activity, motor competence, perceived competence, health-related fitness, and weight status (see Figure I.2; Robinson et al., 2015a). The term "perceived motor competence" from Stodden et al.'s (2008) model was changed to "perceived competence" in Robinson et al.'s (2015) model to better encompass the varying self-perception domains assessed in research. This study uses the term "perceived competence." Robinson et al. (2015a) identified support for a positive and bi-directional association between physical activity and motor competence, partially mediated by perceived competence. However, the authors found inconclusive evidence of these associations within adolescents and adults due to limited studies; they thus recommended that scholars further examine the mediation of perceived competence (Robinson et al., 2015a). Of note, Robinson et al.'s (2015a) model altered the placement of motor competence and physical activity from that of Stodden et al. (2008). However, this change is not applicable to the present study; weight status was not evaluated as an outcome in this work. These two models were most prominent in developing the conceptual model guiding this study, specifically (a) to further examine associations among physical activity, motor competence, and perceived competence in children and adults and (b) to expand these models to explore associations among physical activity, motor competence, and perceived competence in parent-child dyads.

Conceptual Model

The research questions and hypotheses of this dissertation study resulted in a conceptual model similar to that developed by Stodden et al. (2008) and supported by Robinson et al. (2015a). The framework guiding this study is a positive bi-directional association between physical activity and motor competence, partially mediated by perceived competence in parents and children (see Figure I.3). If perceived competence is a partial mediator, it will help explain the association between physical activity and motor competence in parents and children. Additionally, we examined associations of physical activity, motor competence, and perceived competence in parent-child dyads. Lastly, we examined parents' and children's beliefs (i.e., knowledge, perceptions, and engagement) about physical activity and motor competence through semi-structured interviews and triangulation of data sources. The conceptual model framing this study extends the work of Stodden et al. (2008) and Robinson et al. (2015a) by incorporating adults, developing a better understanding of associations between parent-child dyads, and examining beliefs about physical activity and motor competence.

Figure I.3. Conceptual model guiding this dissertation.

Theory

This study is situated within the social ecological model, focusing on interpersonal and intrapersonal determinants. The main theory underpinning this study is social cognitive theory (SCT). SCT is an interpersonal theory based on the reciprocal determinism of behavioral factors, personal factors, and environmental factors that collectively influence a person to engage or not engage in health-enhancing behaviors (Hayden, 2014). Behavioral factors include actions that can be classified as either health-enhancing or health-compromising. Personal factors are defined as one's personal abilities in processing information, applying knowledge, and changing preferences. Environmental factors are physical and social factors in an individual's environment that affect one's behavior (Hayden, 2014). Self-efficacy, one's belief in their capacity to properly execute a task, is also a critical component of SCT (Hayden, 2014). These factors directly influence a person's decision to engage or not engage in physical activity.

This study aimed to develop an understanding of some of these determinants by examining physical activity levels, assessing motor competence, distributing questionnaires, and conducting semi-structured interviews. We investigated current behavior in parents and children more concretely by objectively measuring physical activity and motor competence. This study also examined perceived competence, an aspect of self-efficacy, which is reflective of one's perceptions of their ability or competence level. This study further explored the effects of personal factors and the home setting's physical and social environment through questionnaires and interviews. This study examined the impacts of demographics, siblings, parents, availability and accessibility, COVID-19, and self-identified determinants on physical activity and motor competence (see Figure I.4).

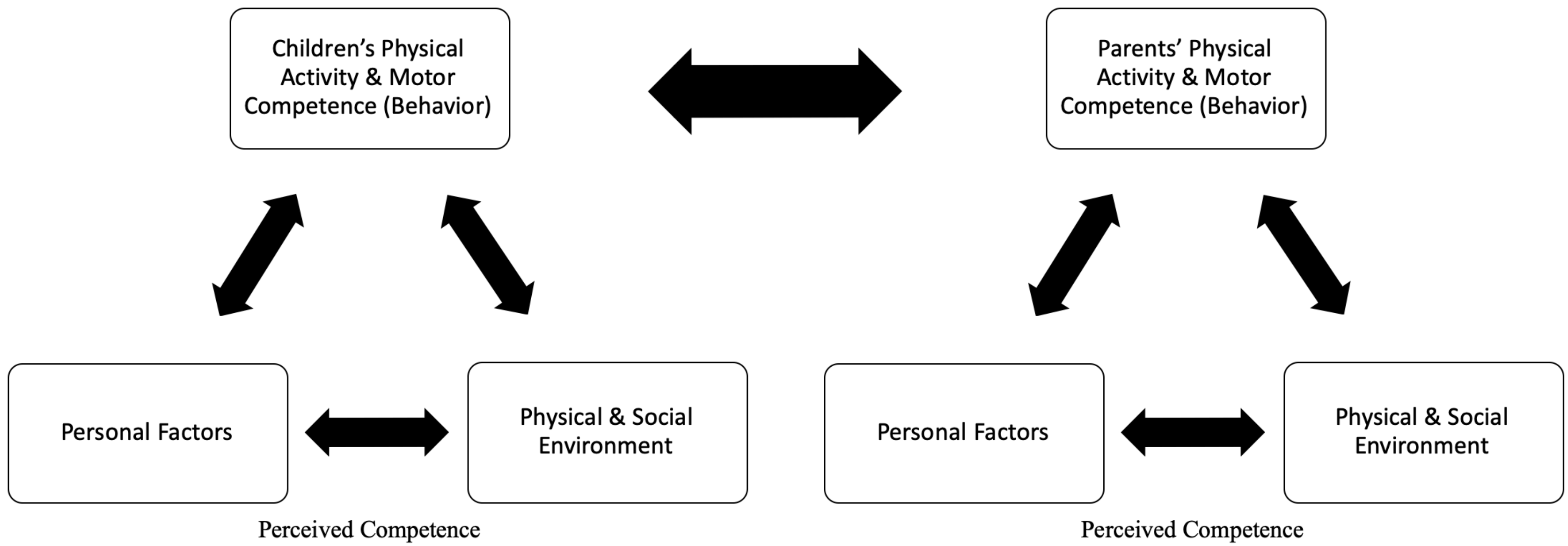


Figure I.4. Social cognitive theory applied to parents' and children's physical activity and motor competence.

COVID-19 Statement

The original purpose of this dissertation study was modified as a result of the COVID-19 pandemic that began affecting the United States in March 2020. Due to executive orders instated across the United States, including in the state of Michigan and at the University of Michigan, the way people live, learn, and conduct research was significantly altered. The purpose and methods of this dissertation study were revised from the original proposal to the following in accordance with executive orders for public health and safety. The changes are outlined in the methods section.

Statement of Purpose

This dissertation study explored associations of and beliefs about physical activity, motor competence, and perceived competence in parents and children (ages 8–11). Using a mixed methods explanatory sequential design, the purpose of this dissertation study was threefold: to (1) examine the associations of physical activity, motor competence, and perceived competence in parents and children; (2) examine the associations between physical activity, motor competence, and perceived competence in parent-child dyads; and (3) investigate beliefs about physical activity and motor competence. A secondary purpose of this dissertation study was to assess the impact of COVID-19 on physical activity and motor competence. All data were collected online. Specifically, we gathered quantitative data and referred to the results to select parent-child dyads for semi-structured interviews focused on beliefs (i.e., knowledge, perceptions, and engagement) about physical activity and motor competence.

Study Need

In considering the best approach to target parents' and children's low physical activity, this study seeks to fill existing research gaps by examining the associations of and beliefs about physical activity, motor competence, and perceived competence in parents and children. The three main research gaps addressed in this study are as follows: (1) the association between physical activity and motor competence in parents; (2) an understanding of the association between physical activity and motor competence in parent-child dyads; and (3) beliefs about physical activity and motor competence in parents and children.

Gap 1. Associations between children's physical activity, motor competence, and perceived competence have been studied extensively (Robinson et al., 2015a). However, these associations remain unclear in adults (Robinson et al., 2015a). This dissertation study extends the small body of work on adults' motor competence (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013) and its association with physical activity (Cantell et al., 2008; Sackett & Edwards, 2019) and the role of perceived competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). To the author's knowledge, this is the first study to explore associations between adult motor competence and physical activity using an objective measurement of physical activity (i.e., an accelerometer) versus self-reported physical activity (Cantell et al., 2008; Sackett & Edwards, 2019).

Gap 2. This study examined associations between physical activity, motor competence, and perceived competence in parent-child dyads. While studies regarding the association between parents' and children's physical activity are limited, even fewer (i.e., a total of four to date) have objectively measured parents' and children's physical activity levels (Hutchens & Lee, 2018; Yao & Rhodes, 2015). This study expands on earlier work that objectively measured physical activity in parents and children (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Given the limited studies regarding adults' motor competence, this study appears to be the first to investigate the association between motor competence and perceived competence in parent-child dyads.

Gap 3. Scarce research has explored individuals' beliefs about physical activity and motor competence. Parents may not possess requisite knowledge about these concepts and thus may hold inaccurate perceptions of them (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020; Silva et al., 2017; Zysset et al., 2018). A lack of accurate knowledge may hinder parents' support of physical activity and motor competence in their children. Quantitative data (i.e., questionnaires, physical activity data, and motor competence data) and qualitative data (i.e., home environment assessments and semi-structured interviews) were gathered in this research to understand parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor competence.

Using quantitative and qualitative data, this dissertation study addressed three major knowledge gaps to enrich research on motor development by exploring associations of and beliefs about physical activity, motor competence, and perceived competence. In particular, this study assessed parents' and children's physical activity objectively, parents' and children's motor competence, associations between parent-child dyads, and parents' and children's beliefs through semi-structured interviews and data triangulation. Of note, this study was completed online due to the COVID-19 pandemic, demonstrating the feasibility of online research in motor development. Because the pandemic has drastically affected how people live, learn, and perform research, a secondary purpose of this study was to evaluate the impact of COVID-19. The results of this study can support physical activity and motor competence in parent-child dyads. Additionally, the findings can be applied to develop more effective and efficient interventions, taking into account how people's lives have been forever altered by COVID-19.

Research Aims, Questions, and Hypotheses

Aim 1: To determine the associations of physical activity, motor competence, and perceived competence in parents and in children.

Research Question 1: What is the association between parents' motor competence and physical activity *(moderate to vigorous and light, moderate, and vigorous activity)*?

Hypothesis 1: Parents' motor competence will have a moderately positive association with physical activity.

Research Question 2: What is the association between children's motor competence and physical activity *(moderate to vigorous and light, moderate, and vigorous activity)*?

Hypothesis 2: Children's motor competence will have a strong positive association with physical activity.

Research Question 3: Does perceived competence *(Self-Perception Profile for Adults/ Children)* partially mediate the association between motor competence and physical activity *(moderate to vigorous)* in parent and children models?

Hypothesis 3: Perceived competence will be a partial mediator between physical activity and motor competence for parents and children.

Aim 2: To examine the associations between physical activity, motor competence, and perceived competence in parent-child dyads.

Research Question 1: What is the association between objectively measured physical activity *(moderate to vigorous and light, moderate, and vigorous activity)* in parent-child dyads?

Hypothesis 1: Parents' physical activity will have a moderately positive association with children's physical activity.

Research Question 2: What is the association between motor competence *(motor competence, process skills, and product skills)* in parent-child dyads?

Hypothesis 2: Parents' motor competence will have a moderately positive association with children's motor competence.

Research Question 3: What is the association between perceived competence *(Self-Perception Profile for Adults/Children)* in parent-child dyads?

Hypothesis 3: Parents' perceived competence will have a moderately positive association with children's perceived motor competence.

Aim 3: To further explore the influence of parents' motor competence on children's physical activity.

Research Question 1: What is the association between parents' motor competence and children's physical activity *(moderate to vigorous and light, moderate, and vigorous activity)*?

Hypothesis 1: Parents' motor competence levels will have a moderately positive association with children's physical activity.

Aim 4: To document and describe beliefs about physical activity and motor competence through semi-structured interviews and triangulation of all data sources to understand motivations and the feasibility of a physical activity intervention.

Research Question 1: What are parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor competence?

1a: What motivates parents and children to engage in physical activity and develop motor competence?

1b: What are parents' perceived roles in encouraging physical activity?

Research Question 2: What do parents and children identify as the benefits and barriers of physical activity?

Research Question 3: How has COVID-19 affected parents' and children's physical activity and motor competence?

Positionality Statement

My research interests are to develop a richer understanding of how to support children to develop the knowledge, skills, and desire to be physically active and to lead a healthy lifestyle. The determinants of physical activity are vast, but it is essential to understand all of them. Examining physical activity and motor competence in parents and children is warranted. My prior research experiences have included being a research assistant on a motor skill intervention; examining the effects of physical activity, motor skills, and social media; and evaluating two after-school running programs. These research experiences did not involve direct work with parents and children.

I acknowledge my positionality as a person who has conducted research on the CSPAP framework and believes that multifaceted interventions will be more effective in targeting and changing children's health behaviors. My prior experiences have influenced my research and beliefs. I am a White female and a person who leads an active and healthy lifestyle. I am a marathon runner, tennis player, conscious food eater, and an advocate of the importance of moving one's body every day. Given my interest in supporting children to become more physically active, I believe my positionality will help guide my research. I want to learn about and discuss their personal knowledge about, perceptions on, and engagement in physical activity and motor competence with families. I understand that making the choice to participate in physical activity is highly complex and multi-dimensional; there will be limitations in identifying beliefs and experiences. Still, I believe my positionality will allow me to learn from and support parents and children and to inform future intervention development.

Definition of Terms

Physical Activity: Any bodily movement produced by skeletal muscles that results in energy expenditure above resting metabolic rate (Caspersen et al., 1985).

Sedentary Behavior: Activities that require minimal energy expenditure (United States Department of Health and Human Services, 2018).

Light Physical Activity: Activities that require standing up and moving around, either in the home, workplace, or community (United States Department of Health and Human Services, 2018).

Moderate Physical Activity: Activities that require some effort, but people can still talk while doing them (United States Department of Health and Human Services, 2018).

Vigorous Physical Activity: Activities that lead to hard breathing, puffing, and panting (United States Department of Health and Human Services, 2018).

Objective Measurement of Physical Activity: A method of evaluating physical activity indirectly through various devices that measure activity counts; these measurements can be compared to energy expenditure. Objective measurement devices include pedometers, accelerometers, heart rate monitors, and a combination of heart rate monitors and accelerometers (Vanhees et al., 2005).

Accelerometer: A small device used to measure the frequency, intensity, and duration of physical activity over specified time intervals (i.e., days of the week) (Vanhees et al., 2005).

Subjective Measurement of Physical Activity: A method of measuring physical activity in which a participant estimates their own energy expenditure. Subjective methods include questionnaires, surveys, surveys, and diaries/logs of physical activity (Vanhees et al., 2005).

Motor Competence: One's proficiency in a wide range of movement skills including locomotor, object manipulation, and stability; often used as a global term to encompass a range of terminology including fundamental motor skills, motor proficiency, motor performance, motor abilities, motor skills, and motor coordination (Robinson et al., 2015a; Stodden et al., 2008).

Fundamental Motor Skills: The "building blocks" of more advanced complex movements required to participate in sports, games, or other context-specific physical activities; includes locomotor skills, ball skills, and stability skills (Gallahue et al., 2012).

Locomotor Skills: A group of gross motor skills that are movements which transport the body from one location to another such as running, skipping, and galloping (Gallahue et al., 2012).

Ball Skills: A group of gross motor skills that are movements involving the manipulation or projection of an object, such as throwing, catching, or striking (Gallahue et al., 2012).

Stability Skills: Skills that maintain postural control in static and dynamic environments, such as logrolling and rocking (Rudd et al., 2015).

Motor Skill Assessments: Assessments that measure different types of motor skills; generally categorized as process-oriented and product-oriented measures (Logan et al., 2018).

Process-Oriented Measures: A way to measure motor skills that assesses the quality of movements performed during skill execution; these are the observable behavioral components that can be observed when executing a skill (Logan et al., 2018).

Test of Gross Motor Development: This is a process-oriented measure, a criterion-based assessment that evaluates children's performance on fundamental motor skills (e.g., locomotor and ball skills). Currently in its third edition, the measured skills include running, galloping, hopping, sliding, skipping, jumping, two-hand strike, one-hand forehand, dribbling, catching, kicking, underhand throw, and overhand throw (Ulrich & Stanford, 1985; Ulrich, 2000, 2019).

Product-Oriented Measures: A way to measure motor skills that assesses the outcome of skill execution (e.g., speed of a throw) (Logan et al., 2018).

Perceived Competence: One's self-perceptions or self-evaluations across multiple domains (Harter, 1999, 2012; Messer & Harter, 2012; Shavelson et al., 1976).

Perceived Motor Competence: One's self-perceptions of their actual movement abilities (Harter, 1999); that is, what a person believes to be their current level of movement competence (Robinson, 2011). In this study, we are assessing perceived competence and perceived motor competence in the domains of athletic competence, physical appearance, and global self-worth from the Self-Perception Profile for Adults and Children (Harter, 2012; Messer & Harter, 2012).

Self-Perception Profile for Adults: This measure was developed to assess perceived competence in adults across the domains of sociability, job competence, nurturance, athletic abilities, physical appearance, adequate provider, morality, household management, intimate relationships, intelligence, sense of humor, and global self-worth (Messer & Harter, 2012).

Self-Perception Profile for Children: This measure was developed to assess perceived competence in children (grades 3–8) across the domains of scholastic competence, social competence, athletic competence, physical appearance, behavioral conduct, and global self-worth (Harter, 2012).

Social Ecological Perspective: A theory-based framework that identifies multifaceted and interactive effects on behavior change at the individual, intrapersonal, organizational, community, and policy levels (Hayden, 2014).

Home Environment Determinants: The concept that both physical and social factors within the home influence children's health behaviors, including parent relationships (Davison et al., 2013; Gattshall et al., 2008; Mâsse et al., 2017).

Physical Activity Parenting: Parents' behavioral strategies to influence their children's physical activity (Laukkanen et al., 2018).

Parent-Child Dyads: The pairing of a child with their primary caregiver. Often this caregiver is a mother; however, the caregiver can be any person who assumes the primary role of daily care for a developing child (Health & Medicine Policy Research Group, 2018).

Beliefs of Physical Activity and Motor Competence: A participant's general knowledge, perceptions, and engagement of physical activity and motor competence.

> Knowledge of Physical Activity and Motor Competence: Information about the definition, development, and how (i.e., examples) to engage in physical activity or promote motor competence.
>
> Perceptions of Physical Activity and Motor Competence: Viewpoints and importance of physical activity and motor competence and current physical activity levels and motor competence levels.
>
> Engagement in Physical Activity and Motor Competence: Types of activities and involvement (i.e., barriers and facilitators) and aspirations of physical activity and motor competence.

Delimitations

The delimitations of this study were as follows:

1. Far-reaching recruitment methods. Parents and children were recruited online through postings on the website of the Child, Movement, Activity, and Developmental Health (CMAH) Laboratory, the Childhood Disparities Research Laboratory (CDRL), and the

University of Michigan research studies registry; through emails sent out on public listservs; and through social media posts on my personal account, the CMAH lab account, and CDRL account.

2. The online format afforded the researcher the flexibility to complete research tasks and eased participant burden from attending in-person assessments.
3. Experienced researchers in motor development and physical activity developed the motor competence assessment directions for participants to follow. Additionally, a trained researcher and undergraduate research assistant coded these assessments. When coding process skills, the author and the trained researcher had an interclass correlation coefficient of 0.88. When coding product skills, the author and the undergraduate research assistant had an interclass correlation coefficient of 0.98.

Limitations

The limitations of this study were as follows:

1. This study used online recruitment methods and study procedures that may have inadvertently excluded various communities.
2. No current motor competence or perceived competence assessments have been developed for online administration.
3. No current fundamental motor skill assessment has been validated for adult populations.
4. Due to the viability of an online motor skills assessment, only four motor skills were assessed. Additionally, only four process measures and two product measures were included in the motor competence variable.
5. COVID-19 orders and procedures for workplaces and schools may have influenced individuals' study participation and altered their physical activity levels and/or motor competence.

6. This research did not examine factors of health-related fitness on physical activity and motor competence.

Chapter II Review of Literature

The purpose of this dissertation study was to explore the associations of and beliefs about physical activity, motor competence, and perceived competence in parents and children (aged 8-11 years). This section provides a comprehensive literature review on all topics related to the purpose of this dissertation study. This review explores studies examining parents' and children's physical activity, motor competence, and perceived competence. In addition, this review incorporates research about parents' and children's overall beliefs, which include knowledge, perceptions, and engagement with physical activity and motor competence. The specific topics reviewed include: physical activity, motor competence, perceived competence, parent determinants on physical activity and motor competence, and parents' and children's beliefs about physical activity and motor competence. This section concludes with the gaps in the literature and the way that this study addressed those research gaps.

Physical Activity

Being physically active is critical for humans: as we are born to move our bodies (Kuhn et al., 2016), recent research has found that physical activity is embedded in our genes (Letsinger et al., 2019). Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen et al., 1985). Physical activity is often confused or used interchangeably with the term exercise. However, exercise is defined as physical activity that is planned, structured, repetitive, and purposive to improve or maintain physical fitness (Caspersen et al., 1985). This means that physical activity can be accumulated throughout the day and with an array of activities, as long as one moves their body above their resting metabolic rate.

Multiple dimensions and domains characterize physical activity (Trost, 2007). The dimensions of physical activity include frequency (i.e., how often), duration (i.e., how long), intensity (i.e., physical effort), and type (i.e., the activity performed). From these dimensions, physical activity intensities are often classified further into either sedentary, light, moderate, vigorous, or a combination of moderate and vigorous activity (see Table II.1, United States Department of Health and Human Services, 2018). These classifications are determined by the energy expenditure of the activity expressed by multiples of the metabolic equivalent of a task (MET). In adults, sedentary behavior is defined as less than one MET, light intensity is less than three METs, moderate intensity is three to six METs, and vigorous intensity is greater than six METs (United States Department of Health and Human Services, 2018). In children, sedentary behavior is defined as less than one and half METs, light is one and half to four METs, moderate is four to six METs, and vigorous is greater than six METs (Trost et al., 2011). While physical activity "type" is generally classified further into five domains: leisure-time, work-related, transportation, activity in the home, and sedentary activity (Brownson et al., 2005). Other domains applicable to children include in school, out of school, and in different behavioral settings (Trost, 2007). There is no specific formula or picture of what physical activity should look like because physical activity can look very different for everyone across individuals, families, communities, and cultures. The most important thing is that humans need to incorporate physical activity across all intensities into their daily lives and routines, as the benefits of being physically active are vast.

Table II.1: Categorization of physical activity levels.

Intensity	Definition	Examples
Sedentary	Activities that require minimal energy expenditure.	▪ Sitting reading or watching television ▪ Standing still/quietly
Light	Activities that require standing up and moving. around; either in the home, workplace, or community.	▪ Hanging out the washing ▪ Ironing ▪ Leisurely/slow walking
Moderate	Activities that require some effort, but you can still talk while doing them.	▪ Brisk walking ▪ Recreational swimming ▪ Social tennis
Vigorous	Activities that lead to harder breathing, puffing, and panting.	▪ Aerobics ▪ Jogging ▪ Competitive sports

Physical Activity and Health

The 2018 Physical Activity Guidelines for Americans summarize the most comprehensive and up-to-date research on the importance and significance of physical activity and provides recommendations on frequency, duration, and intensity of activity for both children and adults (United States Department of Health and Human Services, 2018). Increasing physical activity and reducing sedentary behaviors decreases ones' overall risk for all-cause mortality (see Figure II.1, United States Department of Health and Human Services, 2018). According to the 2018 Physical Activity Guidelines Report, the benefits of physical activity for children aged 6-17 years include improved cognitive function, cardiorespiratory and muscular fitness, bone health, cardiovascular risk factor status, weight status, and fewer symptoms of depression (United States Department of Health and Human Services, 2018). Adults' benefits include all-cause mortality, cardio-metabolic conditions, cancer, brain health, and weight status (United States Department of Health and Human Services, 2018). Two recent systematic reviews also reported similar benefits of physical activity in children (Poitras et al., 2016) and adults (Reiner et al., 2013). These two reviews summarized existing evidence of the relationship between physical activity and various health indicators. Poitras and colleagues (2016) found in school aged children (5-17 years old) physical activity was positively associated with adiposity, cardio-metabolic biomarkers, physical fitness, and bone health and moderately associated with quality of life and well-being, motor skill development, and psychological distress (Poitras et al., 2016). Reiner and colleagues (2013) found in adults aged 18-85 physical activity is a protective factor of weight gain and obesity, coronary heart disease and type 2 diabetes mellitus, and age-related diseases dementia and Alzheimer's disease (Reiner et al., 2013). Physical activity promotes overall positive health outcomes in both children and adults while the effects of physical inactivity are detrimental, thus making it a critical behavior to target.

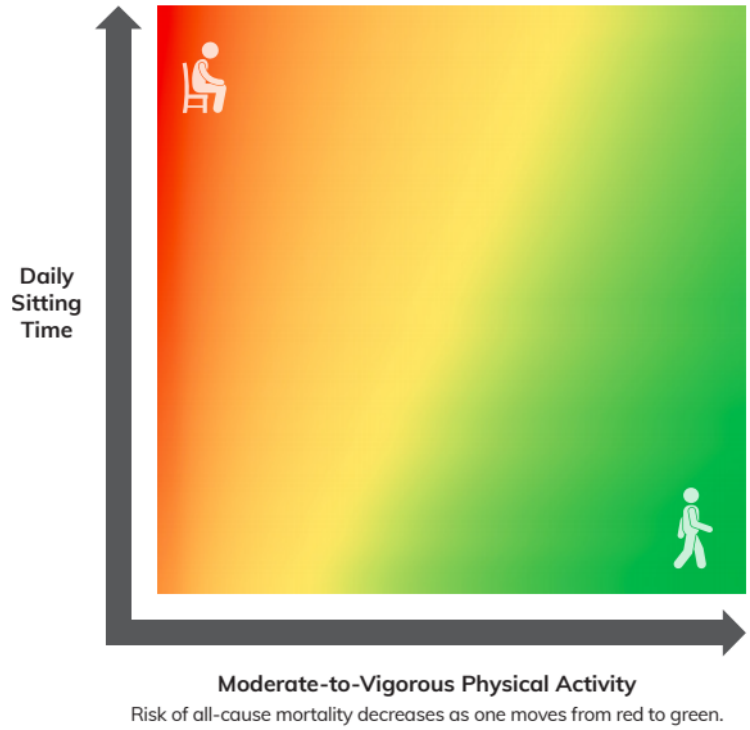


Figure II.1. Relationship between sedentary behavior and MVPA (US Department of Health and Human Services, 2018).

Physical inactivity is a consequential problem that is currently viewed as a worldwide pandemic (Althoff et al., 2017; Hallal et al., 2012; Kohl et al., 2012). Physical inactivity is the fourth leading cause of death worldwide, attributed directly to numerous non-communicable diseases (World Health Organization, 2010). Physical inactivity has been linked to weight gain, obesity, coronary heart disease, type 2 diabetes, breast cancer, and colon cancer (Lee et al., 2012).

In 2008, physical inactivity contributed to 9% (approximately 1.3 million people) of premature mortality worldwide (Lee et al., 2012). Estimates based on world-wide surveillance studies concluded that if physical inactivity decreased by 25%, approximately 1.3 million deaths could be prevented. If it was eliminated, the life expectancy of the world's population would increase by 0.68 (Lee et al., 2012). Not only is physical inactivity a problem to individual's morbidity and mortality, but in the United States healthcare costs attributed to inactivity are approximately $117 billions of dollars each year (Carlson et al., 2015). Being physically active is important for one's heath (i.e., prevention of diseases and improving quality of life), overall quality of life, and for the Society of the United States. Unfortunately, the fact is that both adults and children are not sufficiently active.

Physical Activity Recommendations

The 2018 Physical Activity Guidelines recommend that children ages 6-17 years old should accumulate 60 minutes of moderate-to-vigorous physical activity (MVPA) each day (United States Department of Health and Human Services, 2018). The majority of the 60 minutes of MVPA should be aerobic, but vigorous intensity activities should be incorporated at least three days a week. The MVPA accumulated should also include both muscle- and bone-strengthening activities at least three days a week. These physical activity recommendations are similar to the 2008 Physical Activity Guidelines, as obtaining 60 minutes of MVPA for children has been accepted and continually referenced as the critical number of minutes that children need to acquire to be a protective factor against numerous health problems (United States Department of Health and Human Services, 2008). The guidelines recommend that adults should accumulate at least 150 to 300 minutes of moderate intensity or 75 minutes of vigorous intensity physical activity a week (United States Department of Health and Human Services, 2018). The physical activities should incorporate muscle-strengthening activities at least two days a week.

The physical activity recommendations for both children and adults are accepted as the fewest number of minutes one should acquire to obtain direct health benefits (Janssen & LeBlanc, 2010; Strong et al., 2005; United States Department of Health and Human Services, 2018). However, any physical activity is beneficial, and the more physically active a person is, the more health benefits they will experience (Janssen & LeBlanc, 2010). The problem is that both children and adults are not meeting the physical activity recommendations (Troiano et al., 2008; Tucker et al., 2011).

Physical Activity Trends in the United States

Troiano et al. (2008) is still the most up-to-date study in the United States that examined objectively measured physical activity using a nationally representative sample (i.e., National Health and Nutritional Examination Survey (NHANES) (2003-2004). This study found that only 42% of children aged 6-11 years old are meeting the physical activity guidelines and that this number drastically declines with age to less than 5% adherence in adults (Troiano et al., 2008). This data also revealed major gender differences, males are more active than females. These gender differences were present across all age groups from 6-70+ and physical activity intensities (Troiano et al., 2008). The decline in physical activity from childhood to adulthood and gender differences have been well documented (Cooper et al., 2015; Ortega et al., 2013). Tucker et al. (2011) used data from the NHANES 2005-2006 to assess self-reported and objectively measure physical activity in adults. This study found that less than 10% of adults are not meeting the physical activity guidelines, and females were even less likely to meet the guidelines (Tucker et al., 2011).

Even though these findings are from the mid-2000s, current research continues to demonstrate that both children's and adult's physical activity levels are extremely low, both in the United States and globally (Althoff et al., 2017; Carlson et al., 2015; Hallal et al., 2012). Our society promotes sedentary behavior, as both children and adults spend the majority of the day engaging in sedentary activities (i.e., desk jobs, sitting in a classroom, watching television). In the United States, occupational, transportation, and at home physical activity levels continue to decline while sedentary behaviors continue to increase (Brownson et al., 2005). Declining levels of physical activity are discouraging as physical activity is so imperative.

Physical Activity National Initiatives

Increasing physical activity has been the primary health initiative of government and national organizations, such as the Centers for Disease Control and Prevention (CDC), the National Academy of Medicine (NAM), the American College of Sports Medicine (ACSM), and the Society of Health and Physical Educators (SHAPE America) and government programs, such as the Move Your Way Campaign (United States Department of Health and Human Services, 2018), the Verb Campaign (Wong et al., 2004), and the Let's Move Campaign (Cappellano, 2011). These programs acknowledge the importance of physical activity on health and the detrimental effects of inactivity, so they have aimed to support children to get active and obtain at least 60 minutes of MVPA each day (United States Department of Health and Human Services, 2018). Additionally, during the COVID-19 pandemic initiatives and resources were developed for the general public and professionals to help support physical activity in both children and adults amid a pandemic. These initiatives were led by many of the institutions listed above including the: CDC, ACSM, SHAPE America (ACSM, 2020; CDC, 2021; SHAPE America, 2021). This study builds off the missions of these government and national organizations. Incorporating and focusing on parents and family's role in promoting physical activity aligns with the missions of all of these programs.

As this research incorporated children and adults, it also aligns with the Comprehensive School Physical Activity Program (CSPAP) framework that is promoted by SHAPE America, CDC, and NAM (Carson & Webster, 2019) that acknowledges that parents and families play a significant role on children's physical activity levels. The goal of CSPAP is to use a multifaceted approach to increase physical activity through the collaboration of multiple entities, which target multiple levels of the ecological model. These different entities include physical education, physical activity during the school day, physical activity before and after school, staff involvement, and family and community engagement (see Figure II.2; SHAPE America, 2017). The core objective of CSPAP is focusing on physical activity within schools; physical education, physical activity during the school day, and physical activity before and after school (Carson & Webster, 2019). Physical activity during the school day is an ideal opportunity to target children's physical activity levels because high quality physical education (Bassett et al., 2013), physical activity during the school day (Beemer et al., 2018), and before and after school physical activity (Beets et al., 2016) have shown to increase children's physical activity levels. However, the minutes that children accumulate during the school are still fall short of the physical activity guidelines of 60 minutes of MVPA per day (Bassett et al., 2013; Beemer et al., 2018; Beets et al., 2016). Schools are an ideal place for physical activity interventions because they have the resources and means to target the majority of children (Institute of Medicine, 2013; Kaphingst & French, 2006), however understanding parent-child associations and beliefs will help researchers support children to be more physically active in a variety of settings (Brown et al., 2016).

Figure II.2. CSPAP framework (SHAPE America, 2017).

Physical Activity during COVID-19

It will be sometime before the lasting impacts of COVID-19 are known on various health behaviors, including physical activity are understood. Even though minimal research has emerged examining physical activity and the COVID-19 pandemic, scholars predict negative trends as the way we live our lives was completely altered due to different executive and stay-at-home orders (Hall et al., 2020; Peçanha et al., 2020). Preliminary findings show that across the world there was a decrease in step count in the first few months of the pandemic (Tison et al., 2020) and that quarantine and isolation contributed to declines in physical activity (Ammar et al., 2020). More research will need to be conducted to determine trends in physical activity and sedentary behavior and the lasting impacts of COVID-19 on society as a whole.

One recent study out of Brazil used a cross-sectional nationwide health survey, found that physical inactivity during the COVID-19 pandemic was associated with poorer mental health outcomes (Werneck et al., 2021). This survey also found that many adults attributed their inactivity to COVID-19 lockdown, however, the researchers did not directly examine physical activity trends (Werneck et al., 2021). Another recent study conducted in the United States using online parent-reported surveys, found that children's (aged 3-18 years) overall and moderate physical activity decreased during the COVID-19 pandemic (Tulchin-Francis et al., 2021). This survey used a modified Godin Leisure-Time Exercise questionnaire before and during COVID-19 and examined overall, light, and moderate physical activity (Tulchin-Francis et al., 2021). Also, this survey found that participation in organized sports and recreation significantly decreased during the COVID-19 pandemic (Tulchin-Francis et al., 2021). As more research emerges, it will be essential to examine and understand the impact of COVID-19 on physical activity. This study was conducted during COVID-19 pandemic (July 2020-February 2021) and contributes to understanding physical activity levels and overall lived experiences by parents and children with physical activity throughout COVID-19.

Motor Competence

Motor development is defined as changes in motor behavior across the lifespan and the processes which underlie these changes (Clark & Whitall, 1989). Researchers in motor development study observable and goal-directed movement patterns (Burton & Miller, 1998; Logan et al., 2018). A major focus within motor development is to develop an understanding of the role of movement in supporting physical activity behaviors. The main theory underlining motor development is that individuals need to develop motor competence to support lifelong movement and physical activity (Clark & Metcalfe, 2002; Seefeldt & Haubenstricker, 1982; Stodden et al., 2008). Motor competence is a global word that encompasses a wide range of terminology including fundamental/foundational motor skills (FMS), motor proficiency, motor performance, motor abilities/skills, and motor coordination. Motor competence is defined as one's proficiency in a wide range of gross motor skills including locomotor, object manipulation, and stability (Robinson et al., 2015a).

As children mature, they progress through the stages of motor development, from reflexive, to pre-adaptive, to fundamental/foundational, to more context-specific, to skilled, and then into the compensation stage. As children progress through stages they are developing motor competence (Clark & Metcalfe, 2002). As explained by Seefeldt's (1980) Proficiency Barrier Theory, The Mountain of Motor Development (Clark & Metcalfe, 2002), and within the Stodden et al. (2008) model; the threshold of developing a substantial level of motor competence to support positive health outcomes and physical activities is past the fundamental stage. The fundamental stage has been noted as a critical time of development because children develop an extensive movement repertoire that is flexible and adaptive to numerous physical activities and more complex movements (Clark & Metcalfe, 2002). It is critical to develop motor competence in the fundamental stage to support lifelong movements as research supports positive associations between motor competence and positive health outcomes (Robinson et al., 2015a; Stodden et al., 2008).

It is important to note, one typically shifts out of the fundamental stage into context-specific in middle childhood. This means that from middle childhood into adulthood, it is believed that individuals below the proficiency barrier of motor competence will have less success and enjoyment in physical activity and sport, leading to a spiral of disengagement and lower levels of physical activity (Stodden et al., 2008). Research has supported the Seefeldt (1980) proficiency barrier both in children (De Meester et al., 2018; Wrotniak et al., 2006) and adults (Stodden et al., 2013). De Meester et al. (2018) and Wrotniak et al. (2006) found that motor competence levels were directly related to minutes of MVPA obtained and Stodden et al. (2013) found that motor competence levels were directly related to fitness levels. These studies further demonstrate the importance of developing motor competence in supporting lifelong movement. The association between motor competence and physical activity will be examined in more detail below.

Fundamental/Foundational Motor Skills

Within motor development, the FMS research is a major area of focus. FMS are skills developed in the fundamental stage of motor development. Due to the prominence of FMS research, and the nature of FMS being foundational for movement, FMS is commonly used interchangeably with motor competence (Logan et al., 2017). FMS are specifically defined as the "building blocks" of more advanced complex movements required to participate in sports, games, or other context specific physical activities and are generally divided into three main categories: locomotor, ball skills (formerly referred to as object control skills), and stability skills (Gallahue et al., 2012). Locomotor skills are movements that transport the body from one location to another.

Examples include running, skipping, and galloping. Ball skills involve manipulating or projecting an object, such as throwing, catching, or striking. Stability skills focus on postural control in both static and dynamic environments such as the log roll and rocking (Rudd et al., 2015). The development of FMS, just like physical activity, is influenced at all levels of the social ecological model, dependent on continuous interactions between the individual's biology and social environment (Clark, 2007). The critical period to develop FMS is in early childhood. Fundamental/foundational motor patterns develop in children aged approximately 1-7 years old, context specific motor skills develop in children aged approximately 7-11 years old, and skillfulness in motor skills develop in children aged approximately 11+ years (Clark, 2007).

It is important to note that one of the most commonly used assessments that measures FMS, The Test of Gross Motor Development (TGMD) only assesses locomotor and ball skills (Ulrich & Stanford, 1985; Ulrich, 2000; Ulrich 2019). This is because historically stability skills have been considered a precursor to FMS, known as movement skill foundations (Burton & Miller, 1998). Recently there has been a call to also include stability skills as a category of FMS (Rudd et al., 2015). Rudd and colleagues found that stability skills are an independent factor in the FMS model with locomotor and ball skills (Rudd et al., 2015). However, there is still no widely used or validated assessment that includes stability skills.

FMS are recognized as essential and an important focus in young children as they support various physical activities and movements (Clark & Metcalfe, 2002). FMS are skills that do not develop naturally through maturation (Clark, 2007), but must be specifically taught (Jiménez-Díaz et al, 2019; Logan et al., 2012; Morgan et al., 2013). Researchers have focused on developing evidence-based interventions to support FMS development to increase physical activity and support positive health outcomes in young children, especially at-risk populations (Logan et al., 2012; Morgan et al., 2013; Palmer et al., 2019; Robinson et al., 2018). In addition, supporting FMS development is recognized by SHAPE America in their National Physical Education Standards (SHAPE America, 2013). Standard One states, “The physically literate individual demonstrates competency in a variety of motor skills and movement patterns” (SHAPE America, 2013). This Standard highlights the importance of motor competence and the known link between physical activity/ general movement and motor competence. FMS competence is critical to examine as it relates to overall motor competence and numerous health outcomes. This study uses the term motor competence, to align with previous research in motor development.

Assessing Motor Competence

Motor competence is assessed through various motor skill assessments (Hulteen et al., 2020). These different motor skill assessments are generally categorized as process-oriented or product-oriented (Hulteen et al., 2020; Logan et al., 2018). Process-oriented measures assess the quality of movements performed during skill execution. These are the observable behavioral components spotted when executing a skill (Logan et al., 2018). The most commonly used process-oriented assessment in children is the TGMD (Logan et al., 2018). The TGMD is a criterion-based assessment that evaluates children’s performance on FMS; locomotor and ball skills. Currently, in its third edition the skills that are measured include: run, gallop, hop, slide, skip, jump, two-hand strike, one-hand forehand, dribble, catch, kick, underhand throw, and overhand throw (Ulrich & Standford, 1985; Ulrich, 2000, 2019). Each motor skill has three to five specific skill criteria, and skill performance trials are scored based on the absence or presence of each specific skill criteria. The TGMD is a valid, reliable, and well-normed assessment for children aged three to ten years old created both for researchers and practitioners (Ulrich & Standford, 1985; Ulrich, 2000, 2019).

Product- oriented measures assess the outcome of a skill execution (e.g., speed of a throw) (Logan et al., 2018). Few studies in children have used product-oriented assessments, but the most commonly used assessment is the FMS Test Package (Logan et al., 2018). The FMS Test package measures the outcomes (i.e., total time or distance of motor skill task) of balance, locomotor, and ball skills (Logan et al., 2018). Despite the FMS Test Package being the most commonly used, there is not a widely accepted product-oriented assessment. Thus, measuring the outcome of various FMS skills, such a jump distance (i.e., standing long jump) and catch percentage, is acceptable in children and young adults (Palmer et al., 2020, 2021; Robinson et al., 2020; Stodden et al., 2013, 2014).

Even fewer studies have combined the use of process- and product-oriented measures to examine motor competence (Logan et al., 2018). However, using both process- and product-oriented measures provides a more comprehensive representation of ones' motor competence and overall best practice within motor development (Robinson et al., 2015a; Stodden et al., 2008). This study uses both the TGMD-3 scoring criteria for the catch, jump, kick, and throw and product scores of jump distance and catch percentage to assess motor competence.

Motor Competence Trends

Children

Current research highlights how children exhibit low levels of overall motor competence, including FMS, both in the United States and globally (Brian et al., 2018, 2019; Goodway et al., 2010; O'Brien et al., 2016). There are also documented gender differences in motor competence, where males significantly outperform females in ball skills in preschool populations (Goodway et al., 2010; Spessato et al., 2012; Vameghi et al., 2013; Yang et al., 2015), elementary-aged children (Hardy et al., 2012), and high school-aged youth (Barnett et al., 2010).

In 2010, Goodway and colleagues examined motor competence in disadvantaged preschoolers (N= 469) in the United States using the TGMD-2 (Ulrich, 2000). They found that 86% of the sample exhibited low motor competence (Goodway et al., 2010). Low motor competence was defined as scoring below the 30^{th} percentile (Goodway et al., 2010). These findings also demonstrate that lower socioeconomic status may be related to motor competence levels (Goodway et al., 2010). A study conducted in 2016 by O'Brien and colleagues in Ireland found that only 11% (out of N= 242) of children aged 12-13 years old exhibited mastery motor competence using the TGMD- 2 test (O' Brien et al., 2016). In O'Brien et al. (2016), 'mastery' was narrowly defined as the correct performance of all skill components on two trials or all skills components but one on two trials. In 2018, Brian and colleagues found that preschool children in both the United States and Belgium (N= 326) exhibit low levels of motor competence when assessed on the TGMD-2 when compared to a United States norm group from 1997-1998 (Brian et al., 2018). Just recently in a diverse sample of children (N= 580) aged 3-6 years old assessed with TGMD-2 found that approximately 47% of the sample had scores in 25^{th} percentile (Brian et al., 2019). There are major limitations to these studies that must be noted. First, all of these studies define motor competence differently and set different thresholds of what is considered competence. In addition, there has been no large-scale surveillance study examining motor competence in young children. Despite these issues, collectively these studies demonstrate that children and adolescents have low motor competence.

Adults

Research is limited to examining motor competence in adults, especially FMS competence. There have only been four studies that have tested motor competence in adults (Cantell, et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013). Cantell et al. (2008) assessed motor competence in 149 children, adolescents, and adults (aged 20 - 60 years) to examine the relationship to health-related indices, including varying metabolic factors and BMI. To measure motor competence, the authors used an updated Movement Assessment Battery for Children edition 4 (MABC-4) a product-oriented motor skill assessment, however this assessment never got validated or cited again in the literature. Cantell et al. (2008) found a positive relationship between health-related indices and motor competence. Thus, suggesting that motor competence plays a significant role in health-related outcomes in adult populations.

Stodden et al. (2009, 2013) examined the relationship between motor competence and physical fitness in a group of 188 college students (aged 18 - 25 years old) using a composite of product-oriented motor skill assessments. They found a strong association between motor competence and physical fitness measures. For Stodden et al. (2009) regression analysis indicated that motor competence accounted for 79% of physical fitness variance (Stodden et al., 2009) and in Stodden et al. (2013) agreement among chi-squares provided evidence for a proficiency barrier of motor competence and health-related fitness (Stodden et al., 2013). It is important to note that the sample was physically fit and had high scores on motor competence assessments (Stodden et al., 2009, 2013). Jiménez-Díaz et al. (2018) examined the association between motor competence and perceived competence in a sample of 119 college students (mean age 19.8). Motor competence was assessed with the TGMD for Adults, a non-validated assessment. The TGMD for Adults, a process-oriented assessment, assessed ten FMS: run, gallop, hop, jump, slide, bounce, throw, catch, kick, and strike. In this study, the sample demonstrated proficient performance in 3 of the 10 skills assessed (Jiménez-Díaz et al., 2018). Proficient performance was defined as a score of 9 or above on a scale of 0-12 (Jiménez-Díaz et al., 2018). More recently, Sackett and Edwards (2019) in a sample of 648 college students (mean age 18.96) examined the associations between motor competence, physical activity and perceived competence. Motor competence was assessed using process and product-oriented measures; with the TGMD and Bruinicks-Oseretsky Test of Motor Proficiency (2nd Edition; BOT). The TGMD locomotor skills assessed included run, gallop, hop, leap, horizontal jump, and slide and the ball skills assessed included strike, dribble, catch, kick, throw, and roll. The BOT skills assessed were upper-limb coordination and running speed/agility.

This study found that motor competence and perceived competence significantly predicted physical fitness (Sackett & Edwards, 2019).

Due to the limited research examining adult's motor competence, studies have utilized assessments that have only been validated in children (Hands et al., 2015). Because there is no validated and reliable measure, both research and comparisons examining adult motor competence are challenging. In Cantell et al. (2008) study the MABC-4 never got validated, in Jiménez-Díaz et al. (2018) the TGMD for adults' assessment they used has never been validated, and in Sackett & Edwards (2019) the TGMD-2 is only a validated measure for children aged up to 10.11 years old and the BOT is validated up to 21 years old. Another limitation of the four studies that have examined motor competence, all but one (Cantell et al., 2008) was conducted in college- aged students and not older adults.

Perceived Competence

Perceived competence is defined as ones' self-perception or self-evaluations across multiple domains (Harter, 1999, 2012; Messer & Harter, 2012; Shavelson et al., 1976). Perceptions of competence are situated within the context of an individual's actual competence. The construct of perceived competence is multidimensional. The main domains of perceived competence include perceived academic competence, perceived social competence, perceived emotional competence, and perceived physical competence (Harter, 1999, 2012; Messer & Harter, 2012; Shavelson et al., 1976). These main domains are broken down into countless subdomains (De Meester et al., 2020; Harter, 1999, 2012; Messer & Harter, 2012). Within the field of motor development, the domain of perceived physical competence is of particular interest regarding the association with physical activity and motor competence (Robinson et al., 2015a; Stodden et al., 2008). Many different terms have been used for the construct of 'perceived physical competence', making it challenging to investigate and compare across studies fully. Within perceived physical competence, another aspect that is highlighted in motor development is perceived motor competence. Perceived motor competence is defined as ones' self-perception of their actual movement abilities (Harter, 1999; Robinson et al., 2011, 2015a; Stodden et al., 2008). It is important to point out that numerous terms have also been used for perceived motor competence including, but not limited to: athletic competence, perceived sports competence, perceived athletic competence, perceived physical ability, and perceived skill competence (De Meester et al., 2020). In this study, perceived motor competence is examined with the term athletic competence.

The term perceived competence will be used throughout this dissertation study. In this study, perceived competence was measured with the Self-Perception Profile in Children (Harter, 2012) and Adults (Messer & Harter, 2012). From the Self-Perception Profile in Children (Harter, 2012) and Adults (Messer & Harter, 2012), athletic competence, physical appearance, and global self-worth were included. Assessing these domains align with previous research in motor development that has been conducted in children (Babic et al., 2014; Barnett et al., 2008, 2011; De Meester et al., 2016, 2018, 2020; Khodaverdi et al., 2015) and adults (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). Perceived competence has been found to be an important factor contributing to both motor competence and physical activity in children (Babic et al., 2014; Barnett et al., 2008, 2011; De Meester et al., 2016, 2018, 2020; Khodaverdi et al., 2015; Robinson et al., 2015a) and adults (De Meester et al., 2020; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). There is no standardized method to assess perceived competence in children or adults and different studies measure varying domains of perceived competence and perceived motor competence. Below I examine the relevant literature examining the associations of perceived competence to motor competence and physical activity in children and adults.

In children, there is evidence that perceived competence is positively associated with motor competence (De Meester et al., 2016, 2018, 2020), physical activity (Babic et al., 2014; De Meester et al., 2016, 2018), and mediates the association between motor competence and physical activity (Barnett et al., 2008, 2011; Khodaverdi et al., 2015; Robinson et al., 2015a). De Meester et al. (2016) (N= 360, mean age 9.5) assessed perceived motor competence with the Self-Perception Profile for Children (Harter, 2012) domain of athletic competence, motor competence with the TGMD-2, and physical activity was assessed with accelerometers. De Meester et al. (2016) found that both higher levels of perceived motor competence and motor competence are associated with higher physical activity levels. Using the same data set and research variables, De Meester et al. (2018) found that perceived motor competence was significantly associated with both motor competence and minutes per day of MVPA, however, mediation was not examined. De Meester et al. (2020) conducted a systematic review to examine the association between perceived motor competence and motor competence in children, adolescents, and young adults (aged 3-24 years). A total of 69 studies were included, and the authors concluded that there was a low to moderate association between actual and perceived motor competence for all ages examined (De Meester et al., 2020).

Babic et al. (2014) conducted a systematic review to examine the strength of the relationship between different self-concepts and physical activity in children and adolescents. The authors concluded that general physical self-concept was defined as perceived competence, perceived fitness, and perceived appearance. All aspects of self-concept were significantly associated with physical activity in children and adolescents (Babic et al., 2014). Perceived competence has the strongest association, perceived fitness was the second strongest association, and perceived appearance had the weakest association (Babic et al., 2014). Some limitations of the Babic et al. (2014) systematic review was the variety of assessments used to assess perceived competence and inconsistencies in the definitions of self-concept.

Barnett et al. (2008) conducted a longitudinal study to examine the relationship between perceived sports competence, motor competence, and physical activity. Barnett et al. (2008) used the Physical Self-Perception Profile that asks questions about sports competence, physical condition, strength, body attractiveness, and physical self-worth. Motor competence was assessed with a process measure (i.e., Get Skilled Get Active) and physical activity was assessed via self-report (Barnett et al., 2008, 2011). Children were first assessed in 2000 (mean age 10.1 years) and then follow-up assessments were conducted in 2006 and 2007. The authors found that perceived competence of sports ability mediates the relationship between ball skill competence and physical activity in adolescents six years later (Barnett et al., 2008). Taking the adolescent data, Barnett et al., (2011) also found that perceived competence mediated the association between ball skills and self-reported physical activity. Khodaverdi and colleagues (2015) further examined the relationship of motor competence, physical activity, health-related physical fitness, and perceived competence in Iranian girls (N= 2160). Perceived competence was measured with The Self-Description Questionnaire with the domains of physical ability, physical appearance, peer relationships, and parent relationships. Motor competence was assessed with the TGMD-2 and physical activity was self-reported (Khodaverdi et al., 2015). Perceived competence mediated the relationship between motor competence and physical activity (Khodaverdi et al., 2015).

In adults, there is limited research that has examined the construct of perceived competence. In adults, perceived competence has been found to be associated with motor competence (De Meester et al., 2020; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019) and physical activity (Sackett & Edwards, 2019), but mediation has not been examined. De Meester et al. (2020) conducted a systematic review and meta-analysis between the domains of perceived motor competence and motor competence. They found a weak, but significant association in young adults. The two studies that have examined perceived competence using the Self-Perception Profile in adults (Messer & Harter, 2012) also found positive associations with motor competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019) and physical activity (Sackett & Edwards, 2019). Jiménez-Díaz et al. (2018) conducted a study to examine the association between motor competence and perceived competence. Jiménez-Díaz et al. (2018) assessed motor competence with an adapted TGMD assessment for adults. This study found using Canonical Correlations that the domains of perceived competence (athletic competence, physical appearance, and global self-worth) were all positively and significantly associated with motor competence (i.e., TGMD). However, the association between the perceived competence domain of athletic competence and motor competence was stronger (r= 0.990) than between physical appearance and global self-worth and motor competence (r= 0.315; r= 0.209, respectively). When examining locomotor and ball skills, there was no significant association between perceived competence and locomotor skills, but there was a significant association between the domains of perceived competence and ball skills (Jiménez-Díaz et al., 2018).

Sackett & Edwards (2019) also found significant associations between perceived competence and motor competence. Motor competence was assessed with both the TGMD (i.e., locomotor and ball skills) and the BOT (i.e., upper-limb coordination, running speed/agility; 2nd Edition). Sackett & Edwards (2019) used correlations to examine the associations between the domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) to motor competence. There was a positive and significant association between the perceived competence domains of athletic competence and motor competence. There was a positive and significant association between the perceived competence domains of physical appearance and global self-worth to the motor competence domains of upper-limb coordination and locomotor skills, but no association was found to running speed/agility and ball skills (Sackett & Edwards, 2019). Sackett & Edwards (2019) also found significant associations between perceived competence and physical activity. Physical activity was self-reported, using the Past-Week Modifiable Activity Questionnaire, which measures participants' engagement in physical activity over the previous seven days. There was a positive and significant association between the perceived competence domains of physical appearance, athletic competence, and global self-worth and physical activity (Sackett & Edwards, 2019). However, upon further analysis using stepwise multiple regression, only the domain of athletic competence was significantly associated with physical activity. Upon further analysis, this significance was for male-only participants (Sackett & Edwards, 2019). Research supports that perceived competence is an important factor to consider in motor competence and physical activity research, even though heterogeneity among the construct and assessments make it difficult to assess and compare with other studies.

Conceptual Models in Motor Development

Currently, the two main conceptual models are guiding the field of motor development: Stodden et al. (2008) and Robinson et al. (2015a). These models build off the main theories supported and proposed by motor development researchers that were discussed above (Clark & Metcalfe, 2002; Seefeldt & Haubenstricker, 1982). The Stodden et al. (2000) model and the updated model developed by Robinson et al. (2015a) explain the pathways and bidirectional associations between motor competence, physical activity, perceived competence, and positive trajectories of health (Robinson et al., 2015a; Stodden et al., 2008). Stodden et al. (2008) explain how motor competence, perceived competence, and health-related fitness are associated with physical activity, thus influencing weight status and obesity (see Figure I.1). Robinson and colleagues (2015a), examined the current literature to support the Stodden et al., (2008) model and found positive associations between motor competence, perceived competence, health-related fitness, and physical activity (see Figure I.2). Within the Stodden et al. (2008) model the construct of perceived competence is highlighted as an important factor mediating the relationship between motor competence and physical activity, and this mediation was further supported by Robinson et al. (2015a). This means that ones' perception of how they move is indirectly related to their motor competence (i.e., how one moves) and physical activity levels (i.e., how much one moves). Perceived competence is an important construct to incorporate in physical activity research with young children and adults (Stodden et al., 2008). These two models guided the development of this study, as they highlight the associations and overall importance of motor competence, physical activity, and perceived competence.

More recently, Hulteen and collegues (2018) developed a conceptual model building of the Stodden et al. (2008) and Robinson (2015a) models to explain physical activity across the lifespan (see Figure II.3). This model further expands on the Stodden et al. (2008) and Robinson et al. (2015) model. The Hulteen et al. (2018) model 1) broadens the types of foundational movement skills associated with physical activity (i.e., traditional and non-traditional examples) 2) recognizes that different cultures, regions, geographic locations participate in different types of motor skills 3) incorporation of numerous physical and psychological attributes that impact both motor skills and physical activity (Hulteen et al., 2018). This model further demonstrates the association between motor competence, physical activity, and perceived competence, while also highlighting other important factors in line with the ecological model impacting ones' behavior. This model has not been fully adapted by the field of motor development but highlights some important shortcomings within the field that have been addressed by previous literature, specifically the issue of the word 'fundamental' and inclusion of different varieties of motor skills (Barnett et al., 2016a). As the Hulteen et al., (2018) model is an extension of the Stodden et al. (2008) and Robinson et al. (2015) models it is also pertinent to this study in understanding the association of motor competence and physical activity in adults and the relation with lifelong movement.

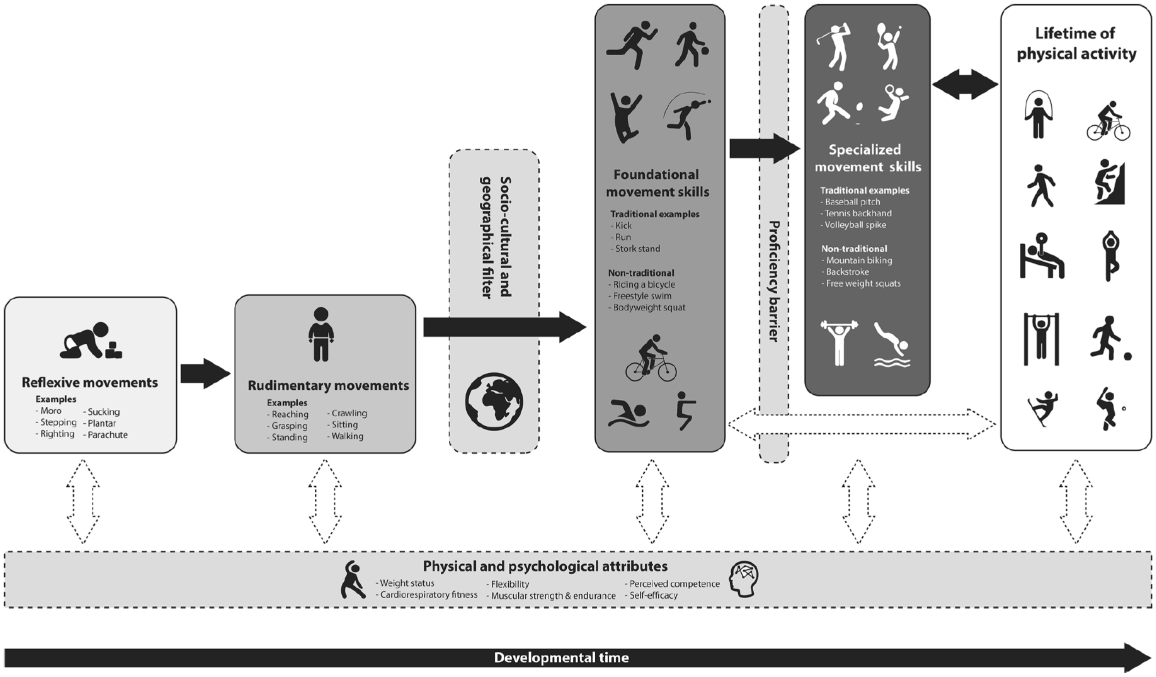


Figure II.3. Conceptual Model Hulteen et al. (2018).

Motor Competence, Physical Activity, and Positive Trajectories of Health

Developing motor competence and more specifically, FMS, are critical because they provide the basis for developing complex movements and the ability to partake in physical activity (Clark & Metcalfe, 2002). In line with Stodden et al. (2008), Robinson et al. (2015a) and Hulteen et al. (2018), research has supported positive associations between motor competence and physical activity in children (Holfelder & Schott, 2014; Logan et al., 2015; Lubans et al., 2010). Four longitudinal follow-up studies have further supported the association between motor competence and physical activity tracks into adolescents (Barnett et al., 2008; Jaakkola et al., 2016; Lima et al., 2017; Venetsanou & Kambas, 2017). Presumably, the association between motor competence and physical activity would track into adulthood. However, little is known between motor competence and physical activity in adults as only two studies have examined this association and both studies used (Cantell et al., 2008; Sackett & Edwards, 2019). Both Cantell et al. (2008) and Sackett and Edwards (2019) did not find a positive association between adult motor competence and physical activity, however, both of these studies used self-reported physical activity measures and unvalidated motor competence assessments (as discussed above in the Motor Competence Section). Cantell et al. (2008) assessed physical activity using the Godin Leisure-Time Exercise Questionnaire. Participants record the amount of time participating in different intensity physical activities over the past seven days. Motor competence was assessed with the MABC-4. There was no significant association found between motor competence and physical activity. However, this study found that motor competence was associated with fitness indices and metabolic indices, the more physically fit and positive health indicators were associated with higher levels of motor competence (Cantell et al., 2008). In Sackett and Edwards (2019) motor competence was assessed with both the TGMD (i.e., locomotor and ball skills) and BOT-2 (i.e., upper-limb coordination, running speed/agility) and physical activity was self-reported, using the Past-Week Modifiable Activity Questionnaire, which measures participants' engagement in physical activity over the previous seven days. Physical activity was positively and significantly correlated with upper-limb coordination, speed/agility, and object control scores, but not with locomotor skills. However, upon further analysis using stepwise linear regressions no measures of motor competence were significantly associated with physical activity (Sackett & Edwards, 2019). Research has demonstrated a positive association between motor competence and physical activity in children and adolescents supporting the three conceptual models discussed above (Hulteen et al., 2018; Robinson et al., 2015a; Stodden et al., 2008) highlighting the importance of motor competence development. More research needs to be conducted in adults to further understand if motor competence and physical activity continues to be associated.

Motor competence has also been found to be positively associated with other positive health outcomes in children and youth, including health-related fitness (i.e., cardiorespiratory fitness and musculoskeletal health) (Cattuzzo et al., 2016), weight status (Cattuzzo et al., 2016; Lubans et al., 2010), and academic performance and cognitive development (Haapala, 2013). In adults, less is known about the associations of motor competence with health outcomes (Robinson et al., 2015a), but evidence suggests that motor competence is significantly and positively associated with weight status (Stodden et al., 2009) physical fitness (Cantell et al., 2008; Sackett & Edwards, 2019; Stodden et al., 2009, 2013), and health indicators (Cantell et al., 2008).

Examining both adult motor competence and perceived competence warrants significant attention. It is possible that parents' levels of motor competence and perceived competence may be affecting their physical activity and health outcomes. It is also important to note that low levels of motor competence in children may be following into adulthood. Research is warranted to examine the association of motor competence, physical activity, and perceived competence in adults. Because motor competence is associated with numerous health outcomes and physical activity it is also important to examine parent-child associations and beliefs about physical activity and motor competence.

Parent Determinants on Physical Activity and Motor Competence

Current Conceptual Models

The varying determinants on physical activity and motor competence can best be explained through a social ecological model, which highlights both the internal and external factors that support or inhibit various health behaviors. A social ecological model is a multilevel framework that is made up of factors at the intrapersonal (individual), interpersonal, institutional, community, and societal level (see figure II.4)

Figure II.4. Social Ecological Model (Hayden, 2014).

(Hayden, 2014). This model was adopted from Urie Bronfenbrenner's social ecological model that describes the interactions of the varying systems influencing an individual (Bronfenbrenner, 1979). Intrapersonal determinants include any individual factors affecting physical activity and motor competence, such as perception, psychosocial factors, knowledge, etc. Interpersonal determinants are the influences of another person on the individual's physical activity or motor competence, including, but not limited to parents, peers, teachers, etc. Organizational factors include any factors at the organizational level that influence the individual, such as schools, sport teams, other clubs, etc. Community determinants include the surrounding neighborhood and built environment, while policy level determinants are local, state, and national policies about physical activity and motor competence.

This framework recognizes the dynamic and continuous interplay among all levels, and the importance of targeting each level to support behavior change (Hayden, 2014). The social ecological model is essential to incorporate in physical activity and motor competence research and intervention development because it permits researchers to specifically target certain determinants, while also considering the complexity of physical activity participation (Taylor et al., 1994) and motor competence. This study will focus mainly on intrapersonal and interpersonal levels by examining both associations and beliefs about physical activity and motor competence.

Prior work in kinesiology examined parental influences on physical activity through the expectancy-value theory proposed by Eccles and Harrold (Eccles & Harrold, 1991; Welk, 1999). Research has shown that the expectancy to be successful and the value of engaging in a task are two essential components of motivation (Wigfield & Cambria, 2010). Expectancies reflect the extent to which a person thinks they can be successful on a task, and value is how worthwhile that task is to the person (Eccles & Harrold, 1991; Kosovich et al., 2014). Expectancy-value theory is an essential motivational theory that has been heavily researched and utilized across psychology because of its link to both performance and ones' choice to engage in various activities, making it applicable to explaining physical activity behaviors. Welk (1999) proposed that there are four main ways a parent can influence their children's physical activity through the expectancy-value theory: 1) parental encouragement 2) parental involvement 3) parental facilitation and 4) parental role modeling (Welk, 1999). This preliminary work influenced the current models today.

In the current literature, three main conceptual models explain parent determinants on children's physical activity (Davison et al., 2013; Gattshall et al., 2008; Mâsse et al., 2017) and these models may be appliable to parent determinants on motor competence as well. Gattshall et al. (2008) developed and validated a survey instrument to access the home social and physical environment on children's eating behaviors and physical activity (see Figure II.5). Gattshall et al. (2008) conceptualized that there are two types of environments within the home physical activity environment that influence children's physical activity: the physical and social environments. The physical environment is made up of physical activity availability and accessibility, while the social environment is made up of parental role-modeling and parental policies around physical activity (Gattshall et al., 2008). All the factors with the physical activity home environment were validated and significantly associated with children's physical activity levels.

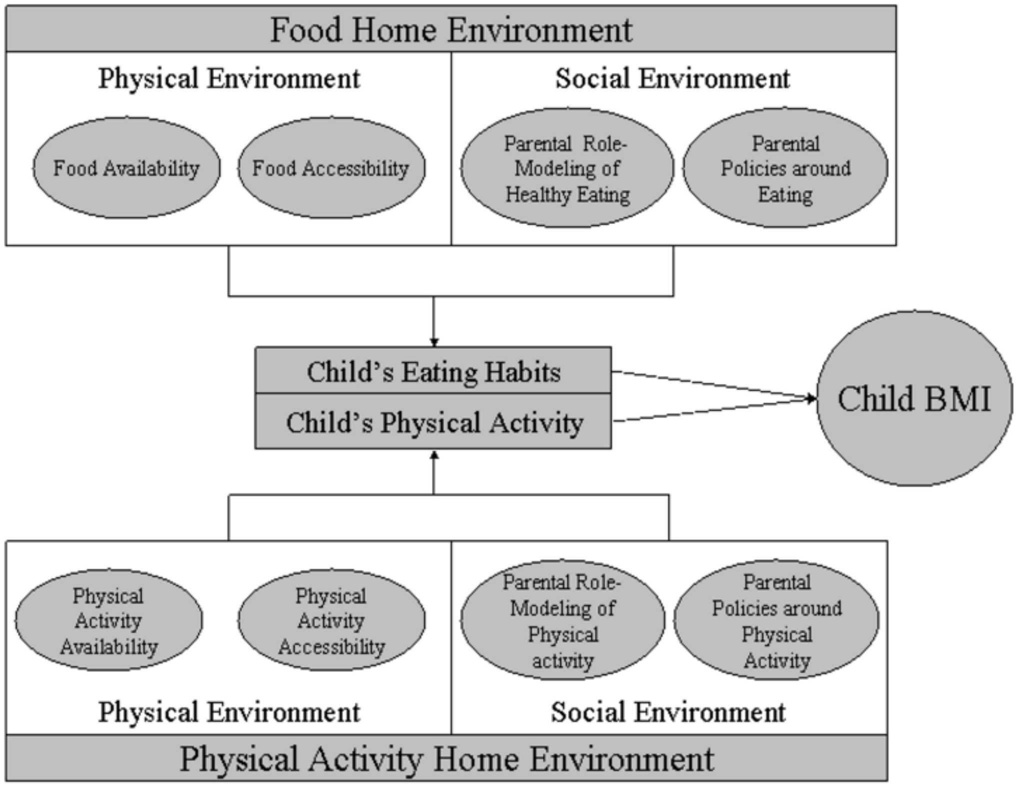


Figure II.5. Gattshall et al. (2008) framework.

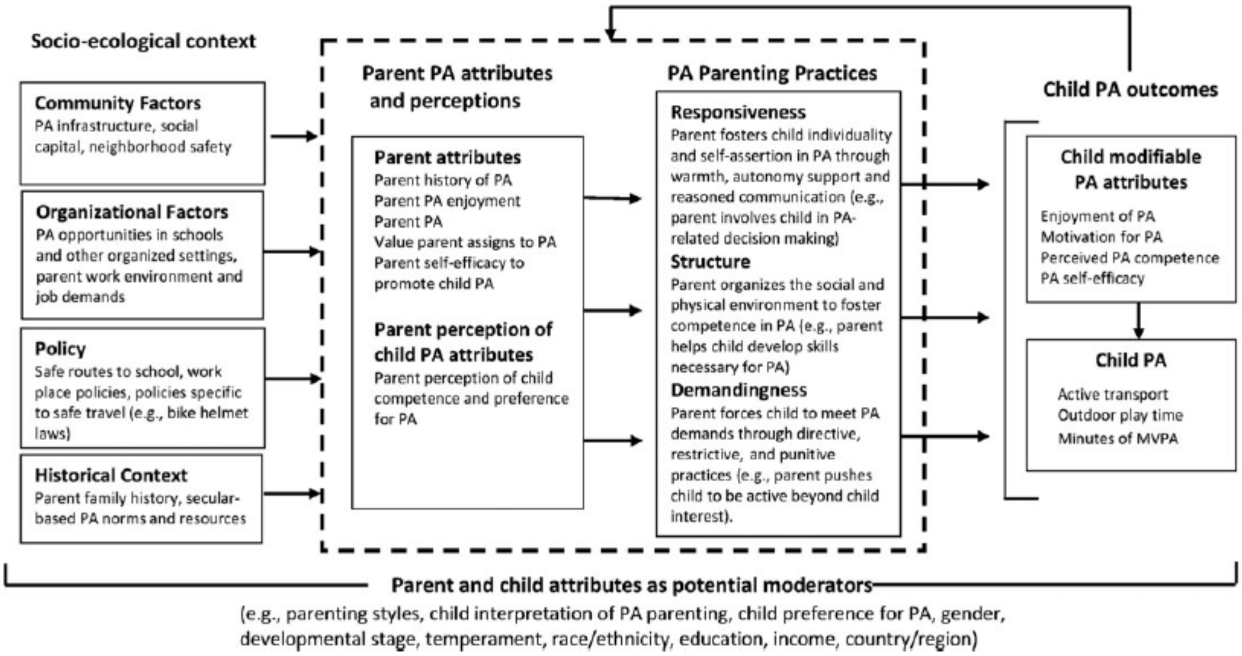


Figure II.6. Davison et al. (2013) framework.

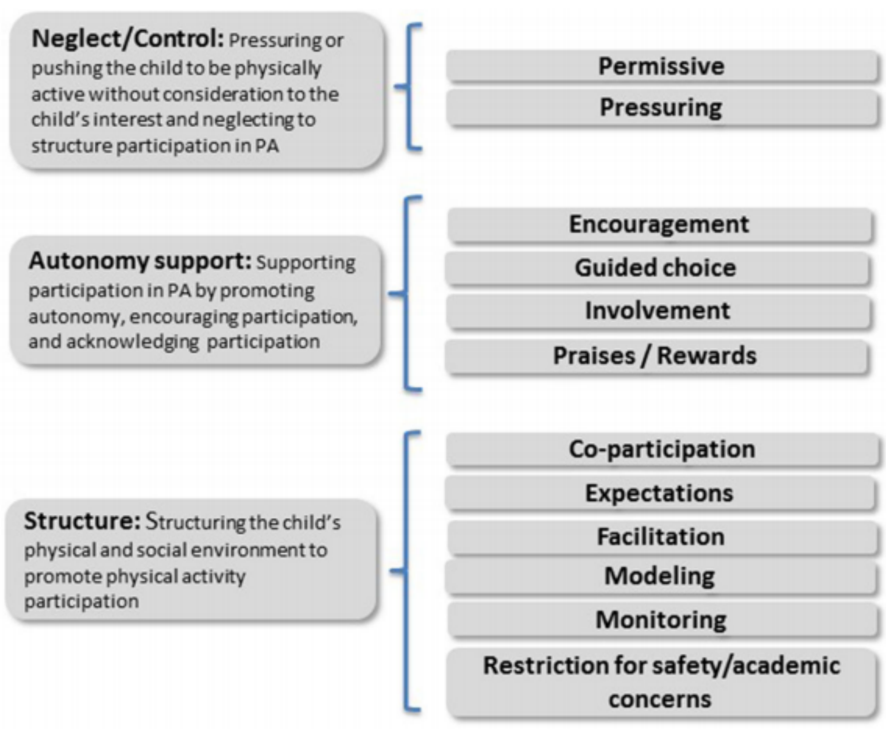


Figure II.7. Mâsse et al. (2017) framework.

Davison et al. (2013) developed a model that aligns with Gattshall et al. (2008), but the Davison et al. (2013) model is targeted to specific parent determinants and focuses solely on physical activity (see Figure II.6). Davison et al. (2013) model situates children's physical activity into a social ecological context, and then highlights parent determinants on children's physical activity behaviors. This model suggests that both parents' physical activity attributes and perceptions and physical activity parenting practices influence children's physical activity (Davison et al., 2013). Parents' physical activity attributes and perceptions include parents' physical activity, value of physical activity, and parents' perceptions of their children's physical activity. These attributes and perceptions then influence different physical activity parenting practices. In this model, physical activity parenting is defined as varying strategies employed by the parent to support physical activity through responsiveness, structures, and demandingness (Davison et al., 2013).

More recently, a board of experts came together to develop a new conceptual model examining the parent determinants on children's (aged 5-12) physical activity to help guide future research (see Figure II.7; Mâsse et al., 2017). This model was developed because research has been inconsistent about the most important parent determinants on children's health behaviors. A conceptual mapping method was utilized by having a panel of experts categorize 77 key parenting practices/determinants. Their findings build off the Davison et al. (2013) model, as attributes and perceptions were categorized into three main domains. The three main domains identified were neglect/control, autonomy support, and structure (Mâsse et al., 2017). Within these three domains important factors are highlighted as having the most influence on children's physical actvitiy.

The Gattshall et al. (2008), Davison et al. (2013), and Mâsse et al. (2017) frameworks provide a foundation for explaining parent determinants on children's physical activity. These models may also be applicable in understanding parent determinants on children's motor competence, as there is limited research and no model has yet been developed. This dissertation study focused on the structure and autonomy support of physical activity parenting and the associated attributes and perceptions found in Davison et al. (2013) and Mâsse et al. (2017).

Parent Determinants on Children's Physical Activity

It is important to examine the current literature on parent determinants of physical activity in their children. As discussed by Mâsse et al. (2017), there have been numerous studies conducted examining parental determinants and practices, but findings have been inconsistent due to the heterogeneity of methods and factors included across studies (Garriguet et al., 2017; Haddad et al., 2018; Hutchens & Lee, 2018; Xu et al., 2015; Yao & Rhodes, 2015). From these studies, determinants that have been highlighted include parental knowledge (Haddad et al., 2018), encouragement (Haddad et al., 2018; Hutchens & Lee, 2018; Xu et al., 2015), support (Garriguet et al., 2017; Hutchens & Lee, 2018; Xu et al., 2015; Yao & Rhodes, 2015), self-efficacy (Xu et al., 2015), and parent's own physical activity behavior (Garriguet et al., 2017; Hutchens & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015). Below I review the most recent reviews and studies that have been conducted to examine the most prevalent parent determinants on children's physical activity found within the literature (Garriguet et al., 2017; Hutchens & Lee, 2018; Neshteruk et al., 2017; Xu et al., 2015; Yao & Rhodes, 2015).

Yao & Rhodes (2015) conducted a meta-analysis of 112 studies to examine parent determinants on children's physical activity and found parental support and parent's behaviors to have a moderate to weak association to children's physical activity. There was a medium effect size ($r = .29$) between parent and child physical activity and they found that the relationship between parental support and child physical activity was moderate in size ($r = .38$) (Yao & Rhodes, 2015). This study also found that gender of the parent moderated the relationship between boy's physical activity and parents' physical activity. Father-son physical activity was significantly higher (r= .29) than mother-son physical activity (r= .19). However, this moderation effect was not found for girls. This meta-analysis is limited due to heterogeneity of studies included. However, it is the most thorough meta-analysis to date conducted examining parent determinants on physical activity in children.

In 2015, Xu and colleagues also conducted a review to examine parental influences on young children's physical activity and screen time and identified 20 studies. Moderate to strong evidence was found in relation to parental support and encouragement and parents modeling of physical activity behaviors (Xu et al., 2015). Before these reviews in 2006, Gustafson and Rhodes reviewed 34 studies that examined parental correlates of children's physical activity behaviors. This review found a significant relationship between parent support and child physical activity levels and found that father's may be more involved in their son's activity (Gustafson & Rhodes, 2006).

Garriguet and colleagues (2017) examined associations between parents' and children's physical activity levels using a combination of objective and self-reported measures. This study examined the determinants of parent's physical activity, support of physical activity, household lifestyle habits, and socio-demographic on children's physical activity using information from the Canadian Health Measures Survey (parent-child dyads N= 1,328, 59% mothers, children aged 6-11 years old). Measures included: questions on a survey, interviews with families, and objectively measured physical activity in parents and children using accelerometers. Parent's physical activity levels and support for physical activity were independently associated with children's physical activity. Also, regardless of parent's physical activity behaviors, supporting children through enrollment in organized sports led to further increases in physical activity (Garriguet et al., 2017). This study also found that the mother's physical activity was more associated with the daughter's physical activity, and the father's physical activity was more related to their son's physical activity

(Garriguet et al., 2017). However, these findings are similar to conclusions made by Yao & Rhodes (2015), but do not align with findings in the review conducted by Neshteruk and colleagues (2017), discussed in more detail below. Mothers and fathers probably influence their children's physical activity differently, however findings are inconclusive due to the limited research that has been conducted with fathers (Neshteruk et al., 2017).

Neshteruk and colleagues (2017) conducted a review of the literature to examine specifically the influence of fathers on children's physical activity. A total of ten studies examined and collectively these studies supported a modest relationship between fathers' and children's physical activity. This review found that father's influenced girls' and boys' physical activity the same, however there are limited number of studies and heterogeneity among methods to make conclusive statements (Neshteruk, et al., 2017). It is possible that mothers and father's influence their children's physical activity in different ways, however the majority of research has been conducted with mothers (Neshteruk et al., 2017; Yao & Rhodes, 2015), as they are generally the primary caregiver of the children and most studies only include one parent.

Hutchens and Lee (2018) conducted an integrative review to examine the influence of parent determinants on children's physical activity from 1998-2017. A total of 30 quantitative and eight qualitative studies were included. The most significant parent determinants were parent's behaviors, parent support, and parent encouragement (Hutchens & Lee, 2018). The authors concluded an overall low to moderate association between parents' and children's physical activity (Hutchens & Lee, 2018). No analyses were conducted on determinants of parent's gender, as only four studies examined included either fathers or a combination of mothers and fathers (Hutchens & Lee, 2018).

In addition to all the reviews discussed above, two studies were published after these reviews were conducted that further examine parent determinants on children's physical activity worth noting. Rodrigues et al. (2018) examined the association between children's participation in extracurricular sport activities to parent's participation in organized physical activity. This study was conducted in a large representative sample of Portuguese children (aged 6-10 years, N= 824). This cross-sectional study found that parents who participated in more organized physical activity were more likely to have children who participated in extracurricular sports activities. Also, having two parents that self-identified as active was associated with more frequent participation of children in extracurricular sports (Rodrigues et al., 2018). This study demonstrates that parents' and children's physical activity behaviors are related. One important thing to note, is that within all these reviews the challenge of making comparisons across studies was discussed as there is currently no standardized protocols or measures to examine parental determinants including physical activity.

Haddad et al. (2018) explored the role of the home and school environment on children's diet, physical activity behaviors, body mass index (BMI). Baseline data from the Australian nation-wide Obesity Prevention and Lifestyle (OPAL) Evaluation Project was collected from 2011-2013. This data consisted of a sample of children aged 9-11, matched with their corresponding parents and school principals (total N= 2466, demographics of parents not reported). Haddad et al. (2018) found that parent intake of fruit and vegetables has the strongest association with child intake of fruit and vegetables in the home diet environment. In the home physical activity environment parent's knowledge and encouragement of physical activity directed towards their child was significantly associated with higher physical activity levels in the children. This study used a large sample size and found significant determinants, but it is important to note that these results were self-reported and conducted in Australia (Haddad et al., 2018).

Even though there are limitations to the reviews conducted by Yao and Rhodes (2015), Xu et al. (2015), Garriguet et al. (2017), Neshteruk, et al. (2017), and Hutchens and Lee (2018) as well as the two studies conducted by Haddad et al. (2018) and Rodrigues et al. (2018) all found that parents play a significant role in influencing children's physical activity behaviors. However, that role is not completely understood, and more studies are needed that directly examine parent determinants.

As noted above, parents' physical activity behaviors are a key factor influencing children's physical activity (Garriguet et al., 2017; Hutchens & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015). Because parents' physical activity behavior has been significant determinant on children's physical activity, it is important to review the methods that have been used to determine this association. One major limitation of many studies examining the association between parents' physical activity behavior and their child's behavior is that few have objectively measured physical activity in the parents and children (Yao & Rhodes, 2015). In the review conducted by Yao & Rhodes (2015) of the 112 studies examined, only 27 studies had at least one objective measurement of physical activity using accelerometers, pedometers, or a heart rate monitor. While only four studies cited assessed physical activity objectively in both the parent and child (Yao & Rhodes, 2015).

All four studies that examined the association between parents' and children's physical activity has found a weak to strong significant positive association (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Only one of these studies was conducted in school-aged children (Fuemmeler et al., 2011), while the other three studies were conducted in preschool-aged children (Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Fuemmeler et al. (2011) used accelerometers to measure parents (45 mothers and fathers), and their children's (N= 45, mean age 10.6 years) physical activity levels over a four-day period. This study found that both mother and fathers MVPA and sedentary behavior were significantly associated with their children's physical activity (r= .39 in fathers and r= .41 in mothers). Additionally, sedentary behavior time and having two parents with higher levels of MVPA was associated with greater levels of activity in children (Fuemmeler et al., 2011). Upon further analysis, mother's physical activity was more positively related to their daughters, while father's physical activity was more positively related to their sons (Fuemmeler et al., 2011). Advantages of this study included two parents and examining physical activity associations between different time periods (i.e., weekday verse weekend) and between sons and daughters (Fuemmeler et al., 2011).

Jago et al. (2014) conducted a large-scale study with at least one parent (N= 1077, 60% mothers) and their children (N= 1456, aged 5-6 years old) using accelerometers. This cross-sectional study found that parental time spent in MVPA was weakly (r= 0.10 in fathers and r = 0.21 in mothers) associated with children's time in MVPA (Jago et al., 2014). Another interesting finding from this study was that 80% of parents met physical activity guidelines (i.e., at least 30 minutes of MVPA per day), however only 71% of boys did and 53% of girls did (Jago et al., 2014). No differences in gender of parents and children's physical activity were found (Jago et al., 2014). Due to the weak association between parents' and children's MVPA, Jago et al. (2014) concluded that parent's behavior may not be very important to children's physical activity.

Ruiz et al. (2011) examined associations between Hispanic parents and their preschool-aged (N= 80 parent-child dyads) child (ages 2-6 years). Ruiz et al. (2011) found a strong positive association between total, low, and moderate physical activity (r= 0.61, r= 0.90 and r= 0.74; respectively), but no association between vigorous physical activity (r= -0.07). Moore et al. (1991) found a moderate association (r= 0.46) between parents and preschoolers (ages 4-7 years old). Moore et al. (1991) used accelerometers to assess physical activity in 100 children, 99 mothers, and 92 fathers. This study found that when both parents were active their child was 5.8 times more likely to be active as well (Moore et al. 1991). Taken together, these four studies demonstrate that there have been few studies that have objectively measured parents' and children's physical activity. Because there has only been one study conducted in school-aged children using objective measurements for physical activity, it demonstrates the need for more studies to investigate the association between physical activity in parent-child dyads. Parent-child dyad refers to the pairing of a child with their primary caregiver. Often this caregiver is a mother, but the caregiver is any person who assumes the primary role of daily care for a developing child (Health & Medicine Policy Research Group, 2018).

It is important to note that there has been some research using objective measurements of physical activity in parents and children that have examined co-participation in physical activity (Dlugonski et al., 2017; Dunton et al., 2012; Hnatuik et al., 2017). These studies examine shared physical activity behaviors that parents and children participate in together, examining sedentary, light, moderate, and vigorous physical activity. These studies found that co-participation of physical activity only accounts for a small proportion of physical activity in both parent's and children's physical activity (Dlugonski et al., 2017; Dunton et al., 2012; Hnatuik et al., 2017). These studies are not included in this review. This study does not focus on co-participation as an outcome, but rather examines the association between physical activity in parent-child dyads.

Parent Determinants on Children's Motor Competence

Research has mainly focused on examining the positive associations between motor competence and health outcomes (Robinson et al., 2015a). There is a lack of research examining parent determinants on children's motor competence (Jarvis et al., 2020). Jarvis et al. (2020) examined parental determinants on children's, aged 9-11 years old, FMS. Children's FMS were assessed with Get Skilled: Get Active (N= 255) and parent's beliefs were assessed with a questionnaire (N= 484). This study revealed that the family environment, parent behaviors, and parent beliefs all influenced FMS, and that different factors influenced FMS performance in boys and girls (Jarvis et al., 2020).

Other research has examined general determinants influencing motor competence in children (Barnett et al., 2016b; Iivonen & Sääkslahti, 2014; Niemistö et al., 2019). Iivonen and colleagues (2014) conducted a systematic review to identify positive determinants of motor competence in preschool-aged children (3-6 years of age). The positive determinants that were identified included individual characteristics, physical activity, physical fitness, education settings (e.g., preschool programs, interventions, etc.), social environment (e.g., parent variables, sports participation, etc.), and physical environment (e.g., neighborhood, play area, etc.) (Iivonen & Sääkslahti, 2014).

Barnett and colleagues (2016b) also conducted a review to examine correlates on motor competence in children aged 3-18 years old. Correlates were categorized into five groups: biological and demographic factors, behavioral attributes and skills, cognitive, emotional and psychological factors, cultural and social factors, and physical environmental factors. A total of 59 studies were included in their review. Biological and demographic factors that were found to be associated with motor competence were that males have better ball skills, age, and BMI is negatively associated. Behavioral attributes and skills that were associated to motor competence were physical activity and less sedentary time. There was limited evidence on studies that have examined cognitive, emotional and psychological factors, cultural and social factors, and physical environmental factors (Barnett et al., 2016b). The study conducted by Jarvis et al. (2020) complements this review, that the environment and social factors of the family influences are associated with children's FMS (Jarvis et al., 2020).

Lastly, Niemistö et al. (2019) investigated environmental determinants on FMS in children aged 3-7 years old). This study examined the geographical location and residential density, time spent outdoors, and participation in organized sports association to children's FMS assessed with the TGMD-3. This study found that time spent outdoors and participation in organized sports was positively associated with FMS competence (Niemistö et al., 2019). The systematic reviews by Iivoenen and colleagues (2013) and Barnett et al. (2016b) and the studies conducted by Jarvis et al. (2020) and Niemistö et al. (2019) demonstrate that parents may play an important role in the development of motor competence, however, there is limited research examining parent determinants (Jarvis et al., 2020). No research has directly assessed the association between motor competence in parent-child dyads. Examining this association warrants further investigation.

Beliefs about Physical Activity and Motor Competence

Quantitative Studies

Beliefs about Physical Activity

I sought to find research that assessed parent's beliefs, including knowledge, perceptions, and engagement with physical activity. As the research highlights above, there are strong determinants between parents' and children's health behaviors. However, the research below demonstrates that parents have some knowledge, but inaccurate perceptions about their children's physical activity.

Knowledge. Findings on parents' knowledge is mixed, Sawyer and colleagues (2014) conducted a telephone interview (n = 1113) asking parents, "Do you know how many minutes of physical activity per day health professionals recommend for young children" respond yes or no if yes prompted to open-ended question to state the minutes (Sawyer et al., 2014). This survey found that only 20% of participants in the United Kingdom correctly respond with the number of recommended minutes, of 60 minutes of MVPA per day for children. However, through a questionnaire, Haddad et al. (2018) found that 74% of parents in Australia knew the physical activity guidelines (i.e., even though this study took place in Australia, they have the same physical activity guidelines as the United States). Additionally, of all the components of the home environment assessed (i.e., knowledge, encouragement, parents self-reported physical activity, and availability), parent knowledge of the physical activity guidelines had the strongest association with child physical activity (Haddad et al., 2018).

Additionally, Scott-Andrews, et al. (in review) distributed an online survey to examine both parent's knowledge about physical activity and motor competence in their child aged 6-12 years old. Out of 250 respondents (86% mothers), 99.6% of parents responded that motor skills are important and 88% identified a difference between physical activity and motor skills (Scott-Andrews et al., in review). Yet this study is not without major limitations, as it was an online distributed survey that defined physical activity and motor skills for the respondents. These findings demonstrate parents have some knowledge about physical activity and motor competence.

Perceptions. Research has found that parents commonly overestimate their children's physical activity levels (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020). Coder et al. (2010) measured physical activity in a total of 1,892 children (mean age 10.3 years) and categorized children as active or inactive. Children were classified as inactive if they obtained less than 60 minutes of MVPA each day. This study found that 39% of girls and 18% of boys were identified as inactive (Corder et al., 2010). Also, 80% of the parents who had children that were identified as inactive believed that their children were sufficiently active. Parent's perceptions of children's physical activity levels were measured using a parent questionnaire (Corder et al., 2010).

Corder et al. (2012) examined parent's perceptions about their children's (N= 329; mean age= 9.1 years) physical activity behaviors. This was measured by asking parents to rate their children's physical activity over a seven-day period, while the child simultaneously wore an accelerometer. Each day parents were asked the daily question, "was your child physically active for a total of 60 minutes on this day?". This study found that parents incorrectly classified their child as meeting physical activity guidelines on days when their child was inactive. Most parents overestimated their children's activity at some point during the study (Corder et al., 2012). Gender of parent was not reported in this study.

Hesketh et al. (2013) assessed mother's perceptions of physical activity in a population-based sample of four- year old children (N= 478) in Britain. In this sample 59% of mothers accurately perceived their child's physical activity, however within the inactive children group (40% of the sample), 90% of mother's reported that their child was active. Another interesting finding of this study was that mothers' who overestimated their children's physical activity perceived their child as lacking skills to be active and less likely to have an older sibling (Hesketh et al., 2013). This indirectly demonstrates that parent's may understand their child does not have sufficient motor skills to be active but may lack knowledge of physical activity and motor competence.

Greca et al. (2016) examined the association between physical activity levels of children and adolescents to both individual perception and parental perception about activity level. In a sample of 306 Brazilian students, 86.6% were classified as inactive based on responses using the Physical Activity Questionnaire for Children. However, both the children (84.6%) and their parents (85.6%) inaccurately perceived their physical activity levels by responding that they were active when they were identified as inactive (Greca et al., 2016).

Scott-Andrews et al. (2020) examined the relationships between parent's perceptions of their preschool children's physical activity and eating behaviors to their child's actual physical activity behaviors using accelerometers, BMI, and body fat percentage (BF %). Scott-Andrews et al. (2020) found that parents (94% mothers) of preschool children who did not meet physical activity guidelines of accumulating 180 minutes per day inaccurately perceived their child as active and did not express any concern.

In addition to being unaware of children's physical activity levels, parents do not express concern for their child's inactivity. Slater et al. (2010) conducted a study in Australia using a computer-assisted telephone interviewing system. This study interviewed 1,202 randomly selected parents of children aged 2-16 years old. In this interview, only 3% of parents indicated a concern for their children's physical activity levels, while 92% of parents thought it was realistic that their children can be active for at least one hour per day (Slater et al., 2010). These studies further demonstrate parents have inaccurate perceptions about their children's physical activity behavior. Parents' and children inaccurately perceive their physical activity behaviors and do not express concern. This shows that parents and children may not have the knowledge about physical activity. It is important to note that most of this research has been conducted with mothers.

Engagement. This is best answered by discussing with parents and children's through qualitative studies. Knowledge and beliefs about physical activity may be inhibiting parents and children to be active.

Beliefs about Motor Competence

Beliefs about motor competence or FMS, in general, is a relatively unexplored area in the literature. There is limited research examining parent's knowledge and perceptions of children's motor competence. Of the research that was compiled all of these studies used varying methods to understand and draw conclusions about parent's beliefs about motor competence.

Knowledge. Scott-Andrews et al. (in review) distributed an online survey to examine both parent's knowledge about physical activity and motor competence in their child aged 6-12 years old. Out of 250 respondents (86% mothers), 99.6% of parents responded that motor skills are important and 88% identified a difference between physical activity and motor skills. These findings demonstrate parents have some knowledge about physical activity and motor competence. Yet this study is not without major limitations, as it was an online distributed survey that defined physical activity and motor skills for the respondents. Another study was recently conducted examining knowledge of motor competence. Jarvis and colleagues (2020) also used a parent questionnaire (N= 484). They found that 59% of parents responded that motor development is important developmental aspect of physical activity and 70% responded that motor development is important for participation in physical activity (Jarvis et al., 2020). These two studies highlight that parents may have accurate knowledge about motor competence and its association with physical activity, but more research is warranted.

Perceptions. Silva et al. (2017) examined mother's perceptions of their children's performance of FMS using the Peabody Developmental Motor Scale 2nd Edition (PDMS-2). This study was conducted in Southern Brazil and participants included 36 mothers and their children (22 boys, 14 girls) aged 16-66 months (1.5-5.5 yrs.) recruited through schools. Mothers' were instructed to identify their children's motor competence based on the FMS skills included in the PDMS-2, while their children performed these skills in a different room with a trained researcher. Mothers' overestimated their children's skill levels on all the motor subsets (Silva et al., 2017). Significant overestimation was found on the subtests of stationary and locomotion skills. It is important to note that there were no significant differences between boys and girls motor skills for actual performance and parents' perceptions. These results demonstrate that mothers are overconfident in their children's abilities (Silva et al., 2017), which may have numerous health implications in promoting motor skills development and encouraging physical activity behaviors. These findings are also interesting to align with inaccurate perceptions within the physical activity literature (Corder et al., 2010; Slater et al., 2010). These findings support the idea that parents believe that their children are more physically active and have higher motor competence than their actual level of motor competence.

Zysset and colleagues (2018) attempted to develop a parent questionnaire to help parents accurately identify children's motor competence. With a sample of 389 children between the aged 3-5 and their corresponding parents (gender of parent not specified), children's FMS were measured using the ZNA3-5 (measures balance, locomotor, and ball skills) and parents responded to a six-question online questionnaire asking about their children's motor competence in swimming, climbing stairs, hopping, riding, balancing, and throwing. The motor competence level reported by parents was weakly to moderately associated with objectively measured motor competence (Zysset et al., 2018). A limitation of this study was that the questions on the questionnaire may not have aligned well with the ZNA3-5. However, this study does provide some evidence that parent's may not accurately perceive their child's motor competence.

However, other studies examining parent's perceptions of perceived competence and actual motor competence have found that parents are fairly good predictors of motor competence in their children (Estevan et al., 2018; Lalor, et al., 2016; Liong, et al., 2015). Liong et al. (2015) had parent's (N= 133, 82% mothers) asses their children's (n = 136, mean age 6.5 years old) motor competence using the Pictorial Scale of Perceived Movement Competence (PSPMC). This measure corresponds to the skills that are assessed on the TGMD-2. Children's motor competence was assessed with the TGMD-2. Parent's perceptions of children's motor competence were significantly associated to the children's actual motor competence (Liong et al., 2015). However, this study found some interesting sex differences that demonstrate parents' may have not had accurate knowledge and perceptions. Parents accurately perceived boys object control skills and girls' locomotor skills, but not the reverse (Liong et al., 2015). Liong et al. (2015) recommend that parents should be educated about locomotor skills and object control skills. If parents know motor competence and motor skills, they can actively promote development in their children.

Lalor et al. (2016) and Estevan et al. (2018) found that both parents' and classroom teachers can report better on children's motor competence than children can report on themselves. In Lalor et al. (2016) parents (n = 55, 98% mothers), classroom teachers, and their children (N= 55, aged 8-9 years old) assessed parents' and teachers' perception of their children's motor competence using a questionnaire. Children's motor competence was assessed using the BOT-2. Parents' and teachers significantly predicted their child's motor competence (Lalor et al., 2016). Similar conclusions were made by Estevan et al. (2018) that examined parents' and physical education teachers' perceptions of their children's (aged 6-11 years old) motor competence. To examine parents' and teachers' perceptions, they were administered the PSPMC and children were administered the TGMD-3. There was a weak to moderate relationship between parents' report and children's actual motor competence, while the physical education teacher had a moderate relationship to children's motor competence. Even though these studies found that parents are good at predicting their children's motor competence (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015), this effect is small and demonstrates that parents need to be educated about motor competence and motor skills.

Engagement. For engagement, this is best answered by discussing with parents and children's through qualitative studies. Beliefs about motor competence may be impacting motor competence ability and development.

Qualitative Studies

Below are qualitative studies that have been conducted examining parents' and/or children's beliefs (knowledge, perceptions, and engagement) about physical activity and motor competence. There are few qualitative studies in the physical activity literature overall and none that focus on motor competence.

Knowledge. Thompson et al (2010) conducted semi-structured telephone interviews with 30 parents of children aged 10-11 years old to examine types of family physical activities and importance, frequency, nature, and barriers to family physical activity. The families represented in this sample were from low, middle, and high socio-economic schools in the United Kingdom. This study offers important insight into family-based physical activity. Most parents in this study perceived participation in physical activity to be important both individually and as a family. Families saw engaging in family physical activity as a way to communicate with their children and to spend time together as a family, the positives of being physically active (Thompson et al., 2010). Even though most parents recognized and discussed the benefits to physically activity, the parents reported that the family as a unit does little physical activity during the week (Thompson et al., 2010).

Perceptions. In a mixed-methods study, Kesten et al (2015) objectively measured physical activity in children 5-6 years old and conducted semi-structured interviews with parents to learn more about perceptions about physical activity. In the sample of 53 children, 15 were identified as inactive, and the parents of these inactive children incorrectly identified their children as active. The semi-structured interviews revealed that many parents are not concerned about their child's physical activity levels and do not need to encourage physical activity. These findings can be attributed to parents misperceiving busyness as getting sufficient amounts of physical activity, not being aware of child's activity when not together, and social comparisons to peers and other siblings (Kesten et al., 2015). Bentley et al. (2012) wanted to examine further parental factors that affect their children's physical activity by conducting a qualitative study using in-depth interviews with 32 parents of children aged 6-8 years old. This study found that most parents categorized their child as either very active or active. From the interviews, the researchers concluded that a parental intervention that targets knowledge of physical activity, awareness, and how to support and encourage physical activity would support parents to increase their children's physical activity levels (Bentley et al., 2012).

Engagement. Brown and colleagues (2015) conducted focus groups with 17 families, who had at least one child between the ages of 8-11 years old, to understand how to best engage the whole family in physical activity participation within research (Brown et al., 2015). This study found that families want to be part of physical activity research that provides social, health, and educational benefits, while also being fun and engaging (Brown et al., 2015). These findings are important for intervention development, but this study did not examine determinants of physical activity nor FMS within the home environment.

Humbert et al. (2006) aimed to understand further the factors that influence physical activity in youth at all physical activity levels (e.g., highly physically active to inactive children). Participants included 160 youth aged 12-18 years old, who participated in small focus groups. The investigators identified participants by socio-economic status based on if the school they attended was designated “high” or “low” according to the demographic and social characteristics of the neighborhood (e.g., community demographics, school data) (Humbert et al., 2006). The study found that environmental factors are important for students designated as “low” socio-economic status, and intrapersonal and social factors are important for all children.

Moore et al. (2010), conducted focus groups with both middle school students and their parents about physical activity barriers and physical activity facilitators to examine the differences identified among rural and urban settings. This study found that parents discussed how important it was to be role models and youth identified determinants as social outlets and availability (Moore et al., 2010). Lastly, Thompson et al. (2003) used semi-structured interviews to describe the relationship of childhood and adolescent physical activity to adult physical activity attitudes and behavior. The interviews were conducted on 16 men and 15 women, who were part of a larger longitudinal study. These participants were asked questions that had them reflect on physical activity behaviors as a child. This study found that children’s physical activity behaviors follow into adulthood (Thompson et al., 2003). Findings from these studies align with the conceptual frameworks of Gattshall et al. (2008), Davison et al. (2013), and Mâsse et al. (2017) and the social ecological model, as physical activity is a multi-component and complicated behavior to understand. Taken all together, these qualitative studies demonstrate the value of qualitative research and how there is a gap in the literature with physical activity and motor competence. This study will examine parents' and children's beliefs about physical activity and incorporate motor competence value.

Gaps in the Literature

This section outlined the current gaps in the literature relative to my research aims and how this dissertation study addressed these gaps (see Table II.2). As discussed in the introduction there are three main research gaps that this study addressed: 1) examined the association between physical activity, motor competence, and perceived competence in **parents**; 2) developed an understanding of **parent-child** associations with physical activity, motor competence, and perceived competence; 3) investigated **beliefs** about motor competence and physical activity.

Research Gap 1

The two prominent motor development conceptual models discussed above highlight the positive associations between physical activity, motor competence, and perceived competence in children and adolescents (Robinson et al., 2015a; Stodden et al., 2008). However, limited research that has examined these known associations in adults (Robinson et al., 2015a). There have only been four studies that have tested motor competence, specifically FMS, in adults (Cantell, et al., 2008; Sackett & Edwards, 2019; Jiménez-Díaz et al., 2018; Stodden et al., 2009, 2013). All four of these studies used different assessments to measure motor competence, and only one used a combination of process and product-oriented assessments (Sackett & Edwards, 2019). Additionally, of the four studies that examined motor competence only two examined the association with physical activity (Cantell et al., 2008; Carson & Sackett, 2019). These studies did not find a positive association between motor competence and physical activity, however, both of these studies used self-reported physical activity measures (Cantell et al., 2008; Carson & Sackett, 2019). Lastly, of the four studies that examined motor competence only two measured perceived competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). Both studies used a version of the Self-Perception Profile (Neemann & Harter, 2012; Messer & Harter, 2012) and found positive associations between perceived competence and actual motor competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019) and physical activity (Sackett & Edwards, 2019).

Dissertation Study Impact. This research added to the limited number of studies that have examined motor competence in adults and then examined the associations between physical activity, motor competence, and perceived competence (Cantell, et al., 2008; Sackett & Edwards, 2019; Stodden, et al., 2009; Jiménez-Díaz, et al., 2018). Motor competence was measured using a combination of process- and product-oriented measures for a more comprehensive representation of ones' motor competence and follows in alignment with best practices (Robinson et al., 2015a; Stodden et al., 2008). This is the second study to use a combination of process- and product-oriented assessments subsequent the research conducted by Sackett & Edwards (2019). The first study examined the associations between adult motor competence and physical activity using an objective measurement of physical activity (i.e., accelerometer) verse self-reported physical activity (Cantell, et al., 2008; Sackett & Edwards, 2019). Having objective measurement of physical activity, means it is also the first study to examine the association of objective measures of physical activity to perceived competence (Sackett & Edwards, 2019).

Research Gap 2

Parent determinants on children's physical activity are extensively researched, and numerous conceptual models have been developed to explain the various influential factors (Davison et al., 2013; Gattshall et al., 2008; Mâsse et al., 2017). Within these models and numerous reviews, conducted a factor that has been highligted as significant is parents' own physical activity behaviors (Garriguet et al., 2017; Hutchens & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015). Many studies have examined the association between parents' and children's physical activity, however only four studies have objectively measured both parents' and children's physical activity levels (Hutchens & Lee, 2018; Yao & Rhodes, 2015). Only one of these studies was conducted in school-aged children (the other three studies were conducted with preschool children) (Fuemmeler et al., 2011). This study found a significant and positive association between parents' and children's physical activity (Fuemmeler et al., 2011). More research is warranted to better understand the association between parents' and children's physical activity. As for motor competence, to the author's knowledge, no studies have examined the associations between parents' and children's motor competence or perceived motor comeptence. Thus, by examining the association between physical activity, motor competence, and perceived competence in parent-child dyads is warranted.

Dissertation Study Impact. This dissertation study assessed physical activity, motor competence, and perceived competence in parent-child dyads permitting analyses between each behavior. The association between physical activity in parent-child dyads was examined, the association between competence in parent-child dyads was examined, and the association between perceived competence in parent-child dyads was examined. By using objective measurement of physical activity in both parents and children adds to the limited research using objective measurements and will help further determine the strength of association between parents' and children's physical activity (Fuemmeler et al., 2011; Jago et al., 2014). By using a process- and product-oriented motor competence assessment provided a more comprehensive representation of ones' motor competence and aligned with best practice (Robinson et al., 2015a; Stodden et al., 2008). Most importantly, this study is the first to examine the association between motor competence and perceived competence in parent-child dyads. The findings will help advance an understanding of parent determinants on children's health behaviors; more specifically physical activity, motor competence, and perceived competence.

Research Gap 3

There is limited research examining beliefs about physical activity and motor competence. Parents' may not have the necessary knowledge about physical activity and motor competence, demonstrated by their inaccurate perceptions about physical activity and motor competence in their children (Corder et al., 2010; 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020; Silva et al., 2017; Zysset et al., 2018). It is probable that parents' lack of knowledge and inaccurate perceptions negatively impact children's physical activity and motor competence. It is critical to understand beliefs about physical activity and motor competence from stakeholders, parents and children. Understanding parents' and children's beliefs about physical and motor competence is best done through qualitative methods. However, qualitative studies are scarce (Bentley et al., 2012; Brown et al., 2015; Humbert et al., 2006; Kesten et al., 2015; Moore et al., 2010; A. Thompson et al., 2003; J. Thompson et al., 2010). None of these qualitative studies specifically discussed concepts of motor competence or provided a comprehensive understanding about parents' and children's beliefs of physical activity.

Dissertation Study Impact. This study collected both quantitative and qualitative data to examine beliefs (i.e., knowledge, perceptions, and engagement) about physical activity and motor competence. Quantitative data was collected through questionnaires and qualitative data was collected through the home environment assessment and semi-structured interviews. This is the first study to examine beliefs about both physical activity and motor competence to the author's knowledge. Questionnaires were completed by 61 parent-child dyads, and through purposeful 12 parent-child dyads participated in the home environment assessment and semi-structured interviews.

Table II.2. Research gaps in the literature and how this dissertation study addresses those research gaps.

	Research Gaps	Dissertation Research	Research Aims
Parents	▪ How do you assess parents' physical activity? ▪ How do you assess parents' motor competence? ▪ What is the association between physical activity, motor competence, and perceived competence in parents?	▪ Assessed parents' physical activity with an Actigraph accelerometer (7-day protocol). ▪ Assessed parents' motor competence using a combination of process (catch, jump, kick, throw) and product measurements (catch percentage, jump distance). ▪ Examined the association of physical activity, motor competence, perceived competence in parents.	▪ <u>Aim 1:</u> To determine the associations of physical activity, motor competence, and perceived competence in parents and in children.
Parent-Child Dyads	▪ What is the association between objectively measured physical activity in parent-child dyads? ▪ What is the association between motor competence in parent-child dyads? ▪ What is the association between perceived competence in parent-child dyads?	▪ Assessed physical activity with an Actigraph accelerometer (7-day protocol). ▪ Assessed motor competence using a combination of process (catch, jump, kick, throw) and product measurements (catch percentage, jump distance). ▪ Assessed perceived competence with Self-Perception Profile for Adults and Children.	▪ <u>Aim 2:</u> To examine the associations between physical activity, motor competence, and perceived competence in parent-child dyads. ▪ <u>Aim 3:</u> To further explore the influence of parents' motor competence on children's physical activity.
Beliefs	▪ There is limited research and few qualitative studies examining beliefs about motor competence and physical activity in parents and children.	▪ 61 parent-child dyads completed questionnaires about beliefs. ▪ 12 parent-child dyads completed the home environment assessment and semi-structured interviews about beliefs.	▪ <u>Aim 4:</u> To document and describe beliefs about physical activity and motor competence through semi-structured interviews and triangulation of all data sources to understand motivations and the feasibility of a physical activity intervention.

Chapter III Methods

The purpose of this study was to: 1) examine the associations of physical activity, motor competence, and perceived competence in parents and in children; 2) to examine the associations between physical activity, motor competence, and perceived competence in parent-child dyads; 3) investigate beliefs about physical activity and motor competence in parents and children. A secondary purpose was to examine the impact of COVID-19 on parents' and children's physical activity and motor competence. This section provides an overview of the specific methods of this study and includes study design, research variables, research procedures, and the data analyses plan. This dissertation study was completed between July 2020 – June 2021. See Figure III.1 for the full research timeline.

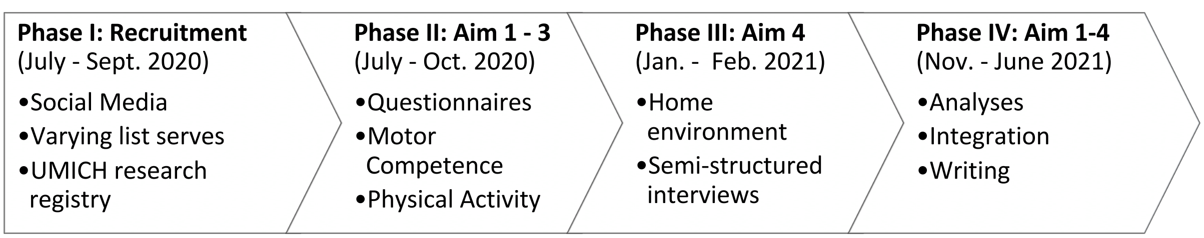


Figure III.1. Research timeline of dissertation.

Study Design

This study was a four-phase mixed methods research study that took place from July 2020 to June 2021. The research utilized a mixed methods explanatory sequential design. First the study collected quantitative data through questionnaires, motor competence assessments, and accelerometers to assess physical activity. This quantitative data examined to select the participants for Phase III, the home environment assessment and semi-structured interviews. The qualitative research findings (Phase III) were used to help explain and understand the conclusions of the quantitative measurement (Phase II) of the study.

Rapid-Cycle Research

As discussed in the introduction, this study was altered from its original format proposed in January 2020 due to the COVID-19 pandemic. My committee and I aimed to align decision-making processes in converting from an in-person study to an online format using the stages of rapid-cycle evaluation (RCE). RCE is defined as "practical problems are identified and addressed using analysis methods that are incremental and contextually informed" (Johnson et al., 2015). The phases of rapid-cycle research are: *preparation*, *problem exploration*, *knowledge exploration*, *solution development*, *solution testing*, and *implementation and dissemination* (Johnson et al., 2015). In converting this dissertation study, the phases of *preparation* to *solution testing* are applicable. For the *preparation*, *problem exploration,* and *knowledge exploration phases,* I sought to figure out the best way to alter my proposal while holding to the original aims of my dissertation study ~ examining associations and beliefs of physical activity and motor competence in parent-child dyads, while also investigating the impacts of COVID-19. My committee, who are experts in Kinesiology and Public Health, met to explore this problem and brainstormed the best evidence-based approaches to proceed forward with this study. As a committee we developed this online study, following best-practices and accepted methodologies. This study is *solution testing* of the updated methodology. Here is an overview of the alterations made to the study:

1) <u>Recruitment:</u> Recruitment was conducted online through online social media, public list serves, and the Michigan Research Registry. Participant eligibility was updated; participants had to be residents of Michigan and have access to filming devices and the internet. The decision to only include Michigan residents was due to individuals having

more similar COVID-19 experiences since each state across the United States had varying regulations and COVID-19 guidelines in place.

2) Quantitative Methodology: Questionnaires were distributed through the online platform Qualtrics (Qualtrics, Provo, UT). Questions examining the impact of COVID-19 on physical activity and motor competence were added to the questionnaires and asked during the semi-structured interview. The parent-child dyad completed the motor competence assessments in their home. Parent-child dyads were emailed directions about how to perform four different motor skills and asked to film their performance. Participants then uploaded their videos to the University of Michigan Box (Box, Redwood City, CA) or Dropbox (Dropbox, San Francisco, CA) application. To assess physical activity, accelerometers were mailed to parent-child dyad homes. Participants were provided with a prepaid envelope to return the accelerometers through the United States Postal Service (USPS).

3) Qualitative Methodology: The Home Environment Assessment and semi-structured interviews were conducted online through the Zoom Video Communications Software Company (Zoom, San Jose, CA).

Using RCE methods is critical during infectious disease epidemics and natural disasters to rapidly collect information, including epidemiological data, information relating to the spread of the disease, health- care information, and health behaviors (Vindrola-Padros et al., 2020). Vindrola-Padros et al. (2020) used an RCE method to carry out three different studies during the COVID-19 pandemic to understand the impacts of COVID-19. Their research highlights the importance of RCE to inform public health responses during times of crises (Vindrola-Padros et al., 2020). Even though RCE is generally utilized in healthcare settings; it is applicable to this study as it was converted to online and incorporated the impact of COVID-19 on health behaviors.

Setting and Participants

Inclusion and Exclusion Criteria

Overall inclusion criteria were participants who lived in Michigan and had access to a filming device and internet. Inclusion criteria for children were open to children of all genders aged 8-11 years old, developmental ability to complete physical tasks, and speaks and understands English. Exclusion criteria for children were previously diagnosed with cardiac disease. Inclusion criteria for parents/legal guardians included the following: had to be the child's primary caregiver, can complete physical tasks, complete questionnaires, participate in the semi-structured interview, and speak and understand English. Exclusion criteria for parents/legal guardians were previously diagnosed with cardiac disease.

Recruitment

This study recruited participants from across the state of Michigan. Recruitment was limited to Michigan for a variety of reasons. First, as discussed above, due to the global pandemic of COVID-19 every state has had varying policies and orders. By targeting one state, we attempted to control for similar experiences concerning governmental policies. Weather plays a significant role in physical activity behaviors. Therefore, we limited the geographical location to help control for similar climate and weather patterns.

The age range of 8-11 was defined based on two main factors. The primary factor for this decision was that this study wanted to include children who were old enough to complete questionnaires and be active participants in the semi-structured interviews, yet still be highly influenced by their parents' health behaviors. All four studies that have objectively examined the association between parents' and children's physical activity have been conducted in young children aged (4-11 years) (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Additionally, in the systematic review conducted by Yao & Rhodes (2015) of the 35 studies that examined parental modeling a stronger association between parents and children's physical activity was found in children aged 5.5–12.4 years with an association of r= .17 while children aged 12.5–19 years had an association of r= .08 (Yao & Rhodes, 2015). The second factor is the Test of Gross Motor Development-3 (TGMD; Ulrich, 2019) is valid in children up to 10.9 years of age. The TGMD-3 has often been used with older children and adolescents (Logan et al., 2018), yet this study did not want to deviate too far from the validated age range.

This study was conducted entirely online, so participants needed internet access and a filming device for the motor skill assessment (e.g., cell phone with camera). This study aimed to recruit a diverse sample representative of Michigan, however, some limitations could not be avoided due to the methods of conducting online research during a global pandemic. Participants self-selected to participate in this online study, and as a researcher, I understand this creates bias.

Participants

For the first phase of the study, the goal was to recruit a total of N= 76 parent-child dyads, children aged 8-11 years. However, if the parent had more than one child meeting the inclusion criteria, all children could participate. This additional child was considered another dyad in line with previous research (Jago et al., 2014; Ruiz et al., 2011). Sample size estimates were conducted using sample size and power calculations software nQuery (nQuery, Cork, Ireland). Based on the findings using objective measurements of physical activity that parents' and children's physical activity is weak to strongly associated, we estimated that parents' and children's physical activity levels would be moderately correlated. Power estimates were conducted using a two-sided Fisher's z test of the null hypothesis that the Pearson correlation coefficient p= 0.5 will have 95% power to detect a p of 0.75 when the sample size is 76. However, this study was unable to meet the sample size of 76 parent-child dyads. Power analysis was rerun in G*Power v.3.1 using an F tests linear multiple regression fixed model, R^2 increase. Using this study's sample size of N= 48 from Aim

2, Research Question 1 that examined the association of physical activity in parent-child dyads and controlling for child gender and parent body mass index (BMI), the calculated effect size f^2= 0.152 has had 76% power to detect a p of 0.05.

For the third phase of the study, purposeful sampling was used to select 12 parent-child dyads to participate in a 30-minute semi-structured interview. Purposeful sampling is a common technique used in mixed methods research to identify and select participants based on different criteria for the most effective use of resources (Palinkas et al., 2016). For this study, a criterion-based sampling design was used to choose parent-child dyads that were most representative of the quantitative data (Palinkas et al., 2016). We decided only to include mothers because past research that has examined parent determinants on physical activity has mainly been conducted with mothers. Generally, only one parent is included in parent determinant studies and mothers are more likely to be the participants (Hutchens & Lee, 2018; Neshteruk et al., 2017; Yao & Rhodes, 2015). Because this study only examines one parent and one child, we hypothesized that most participants would be mothers. Thus, only incorporating mothers in the interviews would be more representative of the quantitative data. Our findings supported this assumption, 83.6% of the sample from Phase II was mothers. The other criterion-based methods this study utilized were examining zip code, gender of the child (i.e., to include 6 girls and 6 boys), parents' physical activity and motor competence levels, and children's physical activity levels and motor competence levels. The selection process was conducted by examining all of the quantitative data. First, we removed fathers, examined zip codes to have a geographical representation, then split up the mother-daughter and mother-son dyads to examine separately, and lastly examined physical activity and motor competence levels. Mother-daughter and mother-son dyads were selected based on high physical activity and high motor skills, medium physical activity and medium motor skills, low physical activity and low motor skills, and a combination of the three. This sampling aimed to represent the combinations of physical activity and motor competence that were observed in the data. The semi-structured interviews were conducted with parent-child dyads through the online program Zoom Video Communications Software Company (Zoom, San Jose, CA).

Research Variables

Below are descriptions of the research variables used in this dissertation study and Table III.2 displays a list of all variables.

Parent Questionnaire

Parents completed a six-part questionnaire consisting of a total of 90 questions (see Appendix B) through Qualtrics (Qualtrics, Provo, UT). The research variables of demographics, anthropometrics, stress, self-reported physical activity behaviors, beliefs about physical activity and motor competence, and perceived competence were obtained from the parents' questionnaires.

Part 1 consisted of 21 questions about demographics for the parent and their child. Data were collected about the parent's relationship to the child, income, education, race/ethnicity, age, gender, height, and weight of the parent and child. Body mass index (BMI) was then calculated from the self-reported age, gender, height, and weight using Centers for Disease Control and Prevention (CDC) Adult BMI Calculator and BMI Calculator for Child and Teen (CDC, 2020). Parents were classified as underweight, BMI below 18.5, healthy weight, BMI 18.5-24.9, overweight, 25.0-29.9, or obese, 30.0 and above (CDC, 2020). Children were classified as underweight, less than the 5^{th} percentile, healthy weight, 5^{th} percentile to less than the 85^{th} percentile, overweight, 85^{th} to less than the 95^{th} percentile, or obese, equal to or greater than the 95^{th} percentile (CDC, 2020).

Part 2 of the questionnaire addressed Perceived Stress Scale (4 items) (Cohen, 1983) and stress questions relating to COVID-19 (17 items). The Perceived Stress Scale is a highly used validated and reliable (α= 0.67-0.82) assessment (Lee, 2012). The Perceived Stress Scale asked about perceived stress in the last month. An example of a question is, “In the last month, how often have you felt you were unable to control the important things in your life?”. Responses are on a 5-point Likert scale ranging from never to very often. Scoring is conducted by coding the items (i.e., reverse code for positive items) and summing across all four items for a maximum of 16 points. A higher score is associated with higher stress levels. The COVID-19 stress questions were developed by experts in Public Health at the University of Michigan to address the stress of the COVID-19 pandemic (Bohnert et al., 2021). Each questions responses are on a 7-point Likert scale from strongly disagree to strongly agree. Questions addressed areas of food insecurity, job security, availability of child care, etc. It was coded and summed across all 17 items for scoring, resulting in a maximum of 108 points. Again, a higher score is associated with higher stress levels.

Part 3 was the Confusion, Hubbub, and Order Scale (CHAOS). The CHAOS is a 15-item instrument designed to be completed by the parent to assess chaos in the child’s home. The CHAOS questionnaire assesses household routines, home organization, and confusion in the home. Examples of questions asked on the CHAOS survey include “There is very little commotion in our home”, “We can usually find things when we need them”, “We almost always seem to be rushed”. Answers range on a 5-point Likert scale from definitely untrue to definitely true. The total score is calculated by adding up the 15 items (many of the items are reversed scored) for a maximum of 75 points, higher score indicates higher levels of household chaos. The CHAOS survey demonstrates good reliability ($\alpha = .79$) (Matheny et al., 1995).

Part 4 consisted of six questions about current, before COVID-19, and past physical activity behaviors. Before COVID-19 and current physical activity behaviors were assessed with the two questions Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985; Godin, 2011). The questionnaire was administered twice, asking to reflect back before COVID-19 and then current behavior. Participants reported how many times a week, on average, they performed strenuous, moderate, and mild exercise for more than 15 minutes and that answer was converted into a scaled score that categorizes the individual as active, moderately active, or insufficiently active/sedentary (Godin & Shephard, 1985; Godin, 2011). The Godin Leisure-Time Exercise Questionnaire is a validated and reliable (α= .74) measure recognized by the American College of Sports Medicine (2007) (Godin & Shephard, 1985, 1997). Past physical activity behaviors were measured with two questions that were derived from a previous study conducted by Conroy and colleagues (2005) examining current and past physical activity behaviors on coronary heart risk in 40,000 female healthcare workers (Conroy et al., 2005). Participants were asked, "How often did you participate in vigorous physical activity or sports at least twice per week?" during high school and during ages 18-22 years and, "What type/s of physical activity or sports teams did you participate in?" during high school and during ages 18-22 years.

Part 5 consists of 12 questions about physical activity beliefs, including knowledge and perceptions of physical activity and motor skills. The author piloted the questions about parents' beliefs of their children's physical activity and motor skills in an online survey, "Interest in a Family-based Social Media Motor Skill and Physical Activity Program" (Scott-Andrews et al., in review).

Part 6 was The Self-Perception Profile for Adults (Messer & Harter, 2012). This assessment was used to measure parent's perceived competence. This instrument evaluates self-perception in 12 domains: sociability, job competence, nurturance, athletic abilities, physical appearance, adequate provider, morality, household management, intimate relationships, intelligence, sense of humor, and global self-worth (Messer & Harter, 2012). It has excellent reliability (α= .81-.92) and validity (Messer & Harter, 2012). Only the domains relevant to the dissertation study aims (e.g., athletic competence (4 items), physical appearance (4 items), and global self-worth (6 items)) were used. Assessing these domains aligns with previous studies that have examined perceived competence in adults (Jiménez-Díaz et al, 2018; Sackett & Edwards, 2019). Responses consist of a four-choice structured-alternative format. The adult is asked to decide which kind of adult they identify most with, the one described in the first part of the sentence or in the second part of the sentence. For example, “some adults do not feel that they are very good when it comes to sports BUT other adults feel they do very well at all kinds of sports”. Next, the adult has to decide whether the description in the part of the sentence they chose is “really true” or “sort of true” for them. Each item was scored from one (low perceived competence) to four (high perceived competence) and then the average of each domain was calculated. The domains were all analyzed separately (Jiménez-Díaz et al, 2018; Messer & Harter, 2012; Sackett & Edwards, 2019). The scores for each domain range between 1-4.

Child Questionnaire

Children completed a four-part questionnaire consisting of 40 questions (see Appendix B) through Qualtrics (Qualtrics, Provo, UT). The research variables of connectedness, self-reported physical activity behaviors, beliefs about physical activity and motor competence, and perceived competence were obtained from the child’s questionnaire.

Part 1 consisted of 10 questions relating to the home environment. The first three questions were based on questions validated by Waters and Cross (2010) about family connectedness. The questions were changed from “family” to “parents” to be more applicable to this study. The questions all had a factor analysis of 0.67 or higher to family “closeness” (Waters & Cross, 2010). The subsequent two questions asked about siblings and their physical activity behaviors.

Part 2 consisted of five questions about beliefs, knowledge and perceptions, physical activity, and motor skills. These questions are similar to those on the parent questionnaire and were also adapted from the piloted survey (Scott-Andrews et al., in review).

Part 3 consists of the validated Physical Activity Questionnaire for Children (PAQ-C) developed by Kowalski et al. (1997). The PAQ-C was administered twice, asking about physical activity behaviors before COVID-19 and current behaviors. Questions were altered slightly for the before COVID-19 questions since the intent of the questionnaire was for children to report their level of physical activity from the last seven days. The PAQ-C has a moderate construct and convergent validity ($r = 0.28$ – $r = 0.57$) to other questionnaires and objective measurements (Kowalski et al., 1997). It has also been found to have high validity and moderate reliability (Richardson et al., 2011). The PAQ-C consists of nine items asking about spare time activity and weekday and weekend activity. A standardized scoring procedure results in a score between 1–5, where 1 indicates low physical activity and a 5 indicates high physical activity (Kowalski et al., 1997).

Part 4 was The Self-Perceptions Profile for Children (Harter, 2012) to assess children's perceived competence. The Self-Perceptions Profile for Children consisted of 17 questions and demonstrated good reliability ($\alpha = .76$ - $.91$) and validity (Harter, 2012). The instrument measures self-perceptions in the domains of scholastic competence, social competence, athletic competence, physical appearance, behavioral conduct, and global self-worth. Only the domains of athletic competence (6 items), physical appearance (6 items), and global self-worth (6 items) were used for this study to align with the aims of this study and to match parents' perceived competence. In children, The Self-Perceptions Profile for Children and similar variations have been used to assess perceived competence (Babic et al., 2014; Barnett et al., 2008; Khodaverdi et al., 2015) and perceived motor competence with the domain of athletic competence (De Meester et al., 2016; 2018). Responding to questions consists of a four-choice structured-alternative format. The child was asked to decide which kind of child they identify most with. First, the child decides if they are like the child described in the first part of the sentence or in the second part of the sentence (e.g.

Some kids do very well at all kinds of sports BUT other kids don't feel that they are very good when it comes to sports). Next, the child had to decide whether the description in the part of the sentence they chose is "really true" or "sort of true" for them. Each item was scored from one (low perceived competence) to four (high perceived competence). The domains were all analyzed separately (Harter, 2012). The scores for each domain range between 1-4.

Physical Activity

Physical activity was assessed using an Actigraph gt3x or gt3x+ trial-axis accelerometer (Actigraph LLC., Pensacola, FL). Actigraph accelerometers are the most reliable objective measurements for physical activity and provide activity counts in three different axes (i.e., vertical, anterior-posterior, and medio-lateral) (Vanhees et al., 2005). Participants were mailed an Actigraph gt3x or gt3x+ monitor (Actigraph LLC., Pensacola, FL) and directions on how to wear it, a physical activity log to record wear time manually, and a prepaid return envelope. Participants were instructed to wear the accelerometer during all waking hours except when in contact with water (e.g., bathing or swimming) around their waist on the right hip for a total of seven days, the recommended wear time to account for both weekdays and weekends (Trost, 2007). All accelerometers were initialized to collect raw data at a frequency of 30 Hz and adjusted to include parents' and children's self-reported body weight, height, gender, and age. Accelerometer output is counts per unit of time. This was converted into measures of MET expenditure that reflect the threshold for the physical activity intensities (e.g., sedentary, light, moderate) (Watson et al., 2014). The physical activity logs were used to validate the wear and non-wear time over the 7-day period.

Analyses were conducted in Actilife (v.13.13; Pensacola, FL). Physical activity data are presented as minutes per day spent in moderate-to-vigorous physical activity (MVPA) and light, moderate, vigorous physical activity. Following standard practice, participants needed to have a minimum of 4 valid days of wear time (valid day defined as ≥ 10 hours of wear time per day) (Trost et al., 2000; Choi et al., 2011). Wear time was classified using the non-wear time algorithm developed by Choi et al. (2011). The Evenson (2008) cut-points were used to classify the intensity of activity for the children, a cut-point that was validated for children 5-8 years old when worn around the waist (Evenson et al., 2008). The Evenson (2008) cut-points have shown to be the most reliable for categorizing physical activity levels (Loprinzi et al., 2012). For adult participants, the cut-points created by Troiano et al. (2008) is a weighted average of four previous studies used to categorize adult physical activity intensity (Loprinzi et al., 2012; Troiano et al., 2008).

Motor Competence

Participants were emailed directions on how to perform four different motor skills (i.e., catch, kick, throw, and jump) at home and film their performance (see Appendix B). The directions were developed by the author and two experts in the field of Kinesiology, each with over ten years of experience in administering motor skills. One of these experts also assisted in coding the process motor skills, discussed in more detail below. The directions were simple, direct, and easy to follow. The participants were instructed to gather up the following equipment: a smartphone, tablet, or another filming device, a small ball/object to throw and catch, a larger ball or equivalent to kick, and optional measuring tape for the jump. Each motor skill had a multimedia demonstration that was uploaded to YouTube (Links to the multimedia demonstrations can be found in the reference section; YouTube, 2020). A multimedia demonstration is an appropriate medium to use with the administration of motor assessments like the TGMD to ensure consistency in the demonstration (Robinson et al., 2015b).

For each motor skill (i.e., catch, throw, kick, and jump), the participants were first instructed to watch the motor skills corresponding multimedia demonstration. Next, the directions instructed the participants to perform one practice trial and then watch the multimedia demonstration again. Then, the participants either performed two test trials for the throw and kick or five test trials for the catch and jump. This sequence was completed for each skill. This sequence was developed based on the standard protocol for administering the TGMD-3 (Ulrich, 2019) and has been used in administering product and process skills (Palmer et al., 2020; Robinson et al., 2020). In these standard protocols, participants perform one practice and two or five test trials for each motor skill. A skill demonstration is administered before the test trial, and if needed, again before the first test trial. The participant (i.e., the parent or child) not performing the motor skill was instructed to film the other participant's performance. Once all four motor skills were performed and filmed by both the parent and child, they uploaded their motor skills videos into their personal Michigan Box (Box, Redwood City, CA) or Michigan Dropbox (Dropbox, San Francisco, CA) folder. The University of Michigan Box (Box, Redwood City, CA) and Michigan Dropbox (Dropbox, San Francisco, CA) are approved secure and confidential platforms.

Process

The established performance criteria of the TGMD-3 (Ulrich, 2019) was used to code the four motor skills; catch, kick, throw, and jump. The TGMD-3 is a valid and reliable process assessment of both locomotor and ball skills for children 3-10.9 years old (Webster & Ulrich, 2017). The catch, kick, throw, and jump are all motor skills that are included in the TGMD-3. Due to the nature of this study being online, the full TGMD-3 assessment (a total of 13 locomotor and ball skills) was not used in this study. Even though the TGMD was developed for children up to age 10.9, it has consistently been used in adolescents and is acceptable to use with children 8-11 years of age (Logan et al., 2018). There is a lack of adult motor assessments and various versions of the TGMD have been administered in adult population (Hands et al., 2015; Jiménez-Díaz, 2018; Sackett & Edwards, 2019). This study used a similar protocol of administering the TMGD-3 to adults that Sackett & Edwards (2019) used in a sample of 648 college-aged students (mean age =

18.96). Sackett & Edwards (2019) only reported raw subscale scores and the data was not converted into percentiles or age-equivalent scores.

Scoring of the TGMD-3 was done by coding the parent-child dyads recorded videos. Palmer et al. (2020) noted that scoring from video recordings is advantageous because it is possible to pause and replay the videos and establish interrater reliability (Palmer et al., 2020). There are three to five specific performance criteria for each motor skill, and the parent or child receives a one if they perform the skill correct and a zero if they fail to perform the criteria. An example of a criteria for the catch, "Child's/ Parent's hands are positioned in front of the body with the elbows flexed". For each skill the parent and child had a practice (that was not recorded) and two trials that were scored. Summed raw scores of the four motor skills resulted in a total score possible of 30. The primary coder for this project was the author, who has a previously established interrater reliability (IRR) of >84% with two external motor experts and the TGMD-3 online training (https://sites.google.com/a/umich.edu/tgmd-3/reliability-videos). A second, blinded expert coder cross-coded 11% of the sample. IRR was measured using consistency, 2-way mixed effects interclass correlations (ICC). ICC values were interpreted as <0.5 "poor", 0.50-0.75 as "moderate", 0.75-0.9 as "good" and >0.90 as "excellent" (Koo & Li, 2016). IRR on the 11% overlap indicated that coders had good reliability (ICC= 0.88, 95% CI [.57- .97]).

Product

A total of two product motor skill measures were assessed: catching percentage (caught balls out of five attempts) and maximum jump distance (out of five trials) from the motor skills of catch and jump. Catching percentage was number of caught balls out of five trials and jump distance was maximum distance measured in centimeters out of five trials. Both product measures are sensitive discriminators for motor competence (Haubenstricker & Branta, 1997; Palmer et al., 2020; Stodden et al., 2014). Additionally, assessing catch percentage and maximum jump distance out of five trials has been used in previous research (Palmer et al., 2020, 2021; Robinson et al., 2020; Stodden et al., 2009, 2014).

Scoring of the product motor skill measures was done by coding the parent-child recorded videos. Catch percentage was calculated as the number of balls caught out of the five trials. Successful catches included: against the body, catching with one hand, or catching with two hands. Jump distance was coded using a video analysis software Dartfish (Dartfish Team Pro6, Fribourg, Switzerland). Parents self-reported height for themselves and their child and used a reference line to measure jump through the video analysis software Dartfish (Dartfish Team Pro6, Fribourg, Switzerland) to the nearest centimeter.

The primary coder of the jump distance was a research assistant in Kinesiology, Movement Science who had worked in the Child Movement, Activity, and Developmental Health Laboratory for three years. This student received training on how to use the video analysis software (Dartfish Team Pro6, Fribourg, Switzerland) and coded all of the jump distance data. The author was a secondary coder who cross-coded 50% of the sample to establish IRR. IRR was measured using consistency, 2-way mixed effects ICC. IRR on the 50% overlap indicated excellent reliability (ICC= 0.98, 95% CI [0.96- 0.99]).

Motor Competence

Motor competence in this study is defined as the combination of participants' scores on both process and product measures. To combine these measures aggregate process and product scores were created by standardizing both process and product measures and then summing the newly created z-scores (Palmer, 2020, 2021; True et al., 2017). The summed z-scores, also referred to as motor competence, was used in analyses unless otherwise stated (see Table III.1).

Table III.1. Motor skill assessments, motor skills, and scoring scale.

Motor Skill Assessment	Motor Skill	Scoring Scale
Motor Competence	Process & Product	Sum of z scores

Process	Catch, Jump, Kick, Throw	Criterion Scale 0-30
Product	Jump	Maximum distance cm 5 jumps
	Catch	Percentage caught 5 balls

Home environment assessment

This five-question assessment was administered to the parent-child dyad at the beginning of the semi-structured interview. The five close-ended questions were developed by the author and an expert in Public Health. Questions were based loosely on a systematic review conducted by Kaushal and Rhodes (2014) that examined factors in the home environment that influence physical activity and a home environment assessment validated for children up to 42 months (Caçola et al., 2015). The questions sought to understand specific home environment factors that may be inhibiting or facilitating physical activity. Items assessed include the type of home (e.g., apartment, townhome, single-family home, other), inside and outside space and physical activity equipment (see Appendix C).

Semi-structured interview

The author developed a semi-structured interview guide to illicit responses regarding beliefs (i.e., knowledge, perceptions, and engagement) of physical activity and motor skills in parent-child dyads. The semi-structured interview guide was developed following a set of standards suggested by Kvale & Brinkmann (2009) for creating a quality interview (Kvale & Brinkman, 2009). Specifically, this guide was designed to generate relevant answers and consisted of short questions that would generate long responses and allow me to summarize and verify my claims and assertions as the interview progressed (Kvale & Brinkmann, 2009). This guide was revised and edited by experts in Kinesiology and Public Health and piloted with five parent-child dyads that were not participants in this dissertation study.

The interview guide began with a brief statement about the purpose of the interview, ensuring that the parent-child dyad was comfortable being recorded, explained the interview goals, and if they have any additional questions. The guide consisted of eight main questions with multiple probing questions. The purpose of the semi-structured interview guide was to stimulate a conversation with the parent-child dyads' beliefs about physical activity and motor skills (i.e. knowledge, perceptions, and engagement), the benefits and barriers of physical activity, and how COVID-19 impacted physical activity. The semi-structured interview guide aligns with Aim 4 and the corresponding research questions (see Appendix C).

All semi-structured interviews were audio-recorded and transcribed through Zoom Video Communications Software Company (Zoom, San Jose, CA). As discussed by Heyl (2001), "Interviewing involves a complex form of social interaction with interviewees, and that interview data are co-produced in these interactions" (Heyl, 2001, p.370). The Zoom application (Zoom, San Jose, CA) is a valuable resource; however, it is not entirely accurate, especially with soft voices. After transcription was complete, the author manually listened to all interviews and made necessary corrections. Because interviewing parents and children involves a complex interaction, as the researcher, certain choices were made in transcription of the interview from oral to written. The goal of the interview transcripts was for them to be as close to verbatim as possible, but do exclude frequent repetitions, minor words such as "mh's and like, laughs, and do not include pauses. The transcribed interviews were imported into qualitative analysis software (NVivo 12; QSR International, Doncaster, Australia).

Table III.2. List of study variables and data obtained.

Variables	Assessment	Data Collection Procedure	Data	Time	Phase
Demographics	Questionnaire	Parent questionnaire	Age, gender, race, relation to child, and socioeconomic status of parent and child	3 min	2
Anthropometrics	Questionnaire	Parent questionnaire	Height (cm), weight (lbs.), BMI	5 min	2
Stress	PSS, COVID-19, & CHAOS	Parent questionnaire	PSS score (range 1-16), COVID-19 score (range 1-108), CHAOS score (range 1-75)	5 min	2
Connectedness	Parent Connectedness	Child questionnaire	Categorical	2 min	2
Self-reported physical activity	Godin leisure-time exercise questionnaire	Parent questionnaire	Categorical	5 min	2
	Physical activity questionnaire	Child questionnaire	Categorical	5 min	2
Beliefs	Beliefs	Parent & child questionnaire	Categorical; beliefs	5 min	2
Perceived competence	Self-Perception Profile for Adults & Children	Parent & child questionnaire	Perceived competence score (range 1-4)	5 min	2
Motor skills- process	TGMD-3	Participant recorded videos	Raw score (range 0-30)	10 min	2
Motor skills-product	Jump distance	Participant recorded videos	cm	10 min	2
	Catching percentage	Participant recorded videos	Percentage		
Motor competence	Process & product	Participant recorded videos	z-scores	n/a	2
Physical activity	Actigraph gt3x or gt3x+	7-day wear protocol, mailed through USPS	Minutes/ day in light, moderate, vigorous, & MVPA	7 days	2
Beliefs	Home environment assessment	Zoom application	Themes	5 min	3
Beliefs & COVID-19 impact	Semi-structured interview	Zoom application	Themes	30 min	3

Note. PSS = perceived stress scale, CHAOS= Confusion Hubbub & Order Scale, MVPA = moderate-to-vigorous physical activity.

Research Procedures

All study procedures were approved by the University of Michigan's Institutional Review Board (HUM00173043). See table III.3 for a summary of study procedures for Phases I-IV. For Phase I, participants were recruited through online methods. Recruitment was completed through postings on the website of the Child, Movement, Activity, and Developmental Health (CMAH) Laboratory the Childhood Disparities Research Laboratory (CDRL), the University of Michigan research studies registry, emails sent out on different public list serves, and through social media posts on the author's personal account, the CMAH lab account, and CDRL account. Participants responded to emails, postings on the internet or social media, or from the Michigan Research Registry. Once eligibility was established, potential participants were emailed a link to University of Michigan Box (Box, Redwood City, CA) or Michigan Dropbox (Dropbox, San Francisco, CA) to sign the consent and assent forms.

In Phase II, consent and assents were signed electronically through the University of Michigan Box (Box, Redwood City, CA) of Michigan Dropbox (Dropbox, San Francisco, CA). Once these forms were signed, the parent-child dyads were sent an email with two separate links to Qualtrics (Qualtrics, Provo, UT) that contained the parent and child questionnaire. The email also included directions on how to film, perform, and upload the motor assessment. After completing the questionnaires and motor assessment, parent-child dyads were mailed accelerometers that included wear instructions and a physical activity log. Parents and children were compensated for the tasks they completed; $5 Visa gift card for completing the questionnaire, $5 Visa gift card for completing the motor skills, and $15 Visa gift card for wearing the accelerometer for 7 days.

In Phase III, purposeful sampling was conducted, and potential parent-child dyads (N= 12) were contacted by email to participate in this phase of the study. A link to an online scheduling platform (Doodle Poll) was provided to assess availability. Participants were scheduled based on their availability for a 30-minute semi-structured interview. Interviews were conducted through Zoom application (Zoom, San Jose, CA) as a video call. Once interviews were transcribed, participants engaged in member checking to ensure that the interview accurately represented physical activity and motor competence beliefs. The parents and children were each compensated with a $10 Visa gift card for participating in the semi-structured interview.

Phase IV focused on integrating the data sources from Phase II and III. Mixed methods analyses helped explain how the objective measurements informed the semi-structured interviews and developed an understanding of associations and beliefs about physical activity and motor skills.

Table III.3. Study procedures.

Phases	I	II	III	IV
Aims	Recruitment	1-3	4	4
Participants	Goal N = 76 parent-child dyads	N = 61 parent-child dyads	N = 12 mother-child dyads	All
Method	Online	Online	Zoom application	Triangulation
Data	Consent & assent	Questionnaires, motor competence & physical activity	Home environment assessment & semi-structured interviews	Integration of all data

Trustworthiness of the Qualitative Data

This dissertation study was an interpretive qualitative research design aimed to understand associations of and beliefs about physical activity and motor competence in parents and children. The qualitative research methods employed helped develop a deeper understanding of associations of and beliefs about physical activity and motor competence and ensure that all claims made were accurate and defensible. Because of my positionality as a researcher who promotes physical activity and due to the nature of a qualitative study, I acknowledge that there were several threats to the trustworthiness of this study that may have influenced the conclusions. Threats to validity included all choices made in the methods and data analyses. However, the study design and data analyses were highly researched, planned, and executed to reduce potential threats.

This study collected data from multiple sources. Data sources included parents' and children's questionnaires, motor competence, physical activity, the home environment assessment, and semi-structured interviews. This data was critical in understanding parents' and children's perspectives and did not result in a data overload. Also, multiple data sources permitted triangulation among data sources, to confirm conclusions. The sequencing of the procedures was strategically planned. This study wanted parents and children to first think about physical activity and motor competence by completing questionnaires, assessing the objective measurements of motor competence and physical activity, and using purposeful sampling for the semi-structured interviews. The sampling methods aimed to recruit a representative sample matching Michigan demographics. Recruitment was conducted via multiple online platforms. Additionally, inclusion and exclusion criteria aimed to be inclusive. The purposeful sampling methods and criterions used to choose the 12 parent-child dyads lessened the threat of selectivity. After the semi-structured interviews, all participants were provided with an opportunity to engage in member checking. The two main strategies to address threats to trustworthiness that were utilized in this study were triangulation and member checking.

Triangulation

Triangulation refers to using different methods to check the accuracy of conclusions made (Maxwell, 2013) and was used in this study. This dissertation study is a mixed methods study collecting from multiple research variables from multiple data sources. Multiple data sources permitted analyses of each research question from a different perspective by using the quantitative and qualitative data collected. Quantitative data sources were questionnaires, motor competence, and physical activity. Qualitative data sources included 12 home environment assessments and semi-structured interviews. These data were all critical and did not result in data overload or saturation.

Member Checking

The semi-structured interviews aimed to understand parents' and children's beliefs by empowering participants to discuss physical activity and motor competence from their perspective. After conducting and transcribing the semi-structured interviews with the parent-child dyads, the interviews were uploaded to their Michigan Box (Box, Redwood City, CA) or Michigan Dropbox (Dropbox, San Francisco, CA) to review, edit, and/or alter in any way. This procedure, known as member checking, ensures that the interviews accurately portrayed the parent-child dyads' beliefs about physical activity and motor competence that was conveyed during the interview. Member checking also cofirmed that researcher bias did not occur; as the researcher aimed to be informed and learn from the parent-child dyads in this study.

Data Analyses

All quantitative data analyses were conducted in IBM SPSS statistics (Version 27), and alpha levels were set to 0.05 a priori (Aims 1-3). Quantitative research variables included demographics, anthropometrics, stress, connectedness, self-reported physical activity, beliefs, perceived competence, motor skills process and product, motor competence, and physical activity. Frequencies and descriptive statistics of socio-demographic characteristics, motor competence (including process and product scores), and physical activity (minutes per day) for both parents and children were calculated to confirm assumptions were met (e.g., linearity). Pearson's correlation coefficients were calculated and interpreted as values of 0.80 or above were considered very strong, values between 0.60 and 0.79 strong, values between 0.40 and 0.59 moderate, 0.20 – 0.39 weak, and 0.00 to 0.19 very weak (Evans, 1996). See Table III-4 for a list of all variables and statistical tests for Aim 1-3 research questions.

All qualitative data analyses were conducted in NVivo (NVivo 12; QSR International, Doncaster, Australia) to help facilitate the coding process by easily sorting, coding, and analyzing the data (Aim 4). Qualitative research variables include the home environment assessment and the semi-structured interview. See Table III.5 for the qualitative analyses research strategy for Aim 4 research questions. Mixed methods analyses were conducted by triangulating all the data. See Table III.6 for a representation of how data sources were integrated.

Research Aim 1

To determine the associations of physical activity, motor competence, and perceived competence in parents and in children.

Research Question 1

What is the association between parents' motor competence and physical activity?

Statistical analysis. Partial bivariate correlations were conducted to examine the association of parents' motor competence and physical activity, controlling for BMI and gender. Data were next analyzed using ordinary least squares (OLS) multiple linear regressions. Physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as the outcome variable; motor competence was the predictor variable; and BMI and gender were added to the model as control variables.

Due to the known bi-directional relationship between motor competence and physical activity, another OLS multiple linear regression models were created with motor competence as the outcome variable; physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) as the predictor variable; and BMI and gender as control variables. There were no significant differences between the models with physical activity and motor competence as outcome variables; therefore, only models containing physical activity as the outcome variable are presented.

Research Question 2

What is the association between children's motor competence and physical activity?

Statistical analysis. Partial bivariate correlations were conducted to examine the association of children's motor competence and physical activity, controlling for BMI and gender. Data were then analyzed using OLS multiple linear regressions. Physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as the outcome variable; motor competence was the predictor variable; and BMI and gender were added to the model as control variables.

Due to the established bi-directional relationship between motor competence and physical activity, OLS multiple linear regression models were constructed with motor competence as the outcome variable; physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) represented the predictor variable; and BMI and gender were control variables. No significant differences emerged between the models with physical activity and motor competence as outcome variables; as such, only the models in which physical activity served as the outcome variable are presented.

Research Question 3

Does perceived competence partially mediate the association between motor competence and physical activity in the parent and children models?

Statistical analysis. No statistically significant association was found between motor competence and physical activity in the parent or children models; thus, mediation could not be calculated. Bivariate correlations and OLS linear regressions were computed. In the first set of linear regressions, motor competence was the outcome variable and the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) served as the predictor variables. In the second set of models, physical activity (defined as minutes per day of MVPA) was the outcome variable and the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were taken as predictor variables. Both bivariate OLS linear regressions were examined in parents and children.

Research Aim 2

To examine the associations between physical activity, motor competence, and perceived competence in parent-child dyads.

Research Question 1

What is the association between objectively measured physical activity in parent-child dyads?

Statistical analysis. Partial bivariate correlations were adopted to examine the association of physical activity in parent-child dyads, controlling for child gender and parent BMI. Data were then analyzed using OLS multiple linear regressions. Children's physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as the outcome variable. Parents' matched physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) constituted the predictor variable; child gender and parent BMI were added to the models as control variables (Jago et al., 2014).

Research Question 2

What is the association between motor competence in parent-child dyads?

Statistical Analysis. Partial bivariate correlations were carried out to evaluate the association of motor competence in parent-child dyads, controlling for child gender and parent

BMI. Data were then analyzed using OLS multiple linear regressions. Children's motor competence served as the outcome variable, parents' motor competence was the predictor variable, and child gender and parent BMI were added to the model as control variables. Additional models were computed with children's process and product motor skills serving as the outcome variables, matched parents' process and product motor skills as the predictor variable, and child and gender added to the models as control variables.

Research Question 3

What is the association between perceived competence in parent-child dyads?

Statistical Analysis. Bivariate correlations and OLS linear regressions were computed. The three domains of children's perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were outcome variables. The three matched domains of parents' perceived competence (i.e., athletic competence, physical appearance, and global self-worth) served as predictor variables.

Research Aim 3

To further explore the influence of parents' motor competence on children's physical activity.

Research Question 1

What is the association between parents' motor competence and children's physical activity?

Statistical Analysis. Partial bivariate correlations were conducted to examine the association of parents' motor competence and children's physical activity. Data were analyzed using OLS multiple linear regressions. Children's physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as the outcome variable, parent's motor competence was the predictor variable, and child gender and parent BMI were added to the models as control variables.

Table III.4. List of variables and statistical tests for Aims 1-3 research questions.

Research Question	Dependent (Outcomes)	Independent (Predictors)	Controls	Analysis
What is the association between parents' motor competence and physical activity?	1. Parents' physical activity 2. Parents' motor competence	1. Parents' motor competence 2. Parents' physical activity	BMI, gender	Correlations and multiple linear regressions
What is the association between children's motor competence and physical activity?	1. Children's physical activity 2. Children's motor competence	1. Children's motor competence 2. Children's physical activity	BMI, gender	Correlations and multiple linear regressions
Does perceived competence partially mediate the association between motor competence and physical activity in the parent and children models?	1. Parents' physical activity and motor competence 2. Children's physical activity and motor competence	1. Parents' perceived competence (AC, PA, SW) 2. Children's perceived competence (AC, PA, SW)	---	Correlations and linear regressions
What is the association between objectively measured physical activity in parent-child dyads?	Children's physical activity	Parents' physical activity	Child gender & parent BMI	Correlations and multiple linear regressions
What is the association between motor competence in parent-child dyads?	Children's motor competence, process skills, product skills	Parents' motor competence, process skills, product skills	Child gender & parent BMI	Correlations and multiple linear regressions
What is the association between perceived competence in parent-child dyads?	Children's perceived competence (AC, PA & SW)	Parents' perceived competence (AC, PA & SW)	---	Correlations and multiple linear regressions
What is the association of parents' motor competence and children's physical activity?	Children's physical activity	Parents' motor competence, process skills, product skills	Child gender & parent BMI	Correlations and multiple linear regression

Note. PC = perceived competence; AC = athletic competence; PA = physical appearance; SW= global self-worth.

Research Aim 4

To document and describe beliefs about physical activity and motor competence through semi-structured interviews and triangulation of all data sources to understand motivations and the feasibility of a physical activity intervention.

Research Question 1

What are parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor competence?

1a: What motivates parents and children to engage in physical activity and develop motor competence?

1b: What are parents' perceived role in encouraging physical activity?

Research Question 2

What do parents and children identify as the benefits and barriers of physical activity?

Research Question 3

How has COVID-19 impacted parents' and children's physical activity and motor competence?

Statistical analyses for Home Environment Assessment and Interviews. Data analyses procedures were guided by the books, *Constructing Grounded Theory: 2nd Edition* by Kathy Charmaz (2014) and *Qualitative Research Design: An Interactive Approach* by Joseph A. Maxwell (2013) (Charmaz, 2014; Maxwell, 2013). As described in Maxwell (2013) data analysis is an ongoing and complicated procedure that is conducted throughout the entirety of the study. This study utilized grounded theory methodology in analyzing the semi-structured interviews and home environment assessment. Grounded theory is a method for data analysis that consists of systematic yet flexible guidelines for collecting and analyzing qualitative data to construct theories from the data themselves, thus researchers are constructing a theory 'grounded' in their data (Charmaz, 2014). This process involved taking an inductive approach to understand and learn from the data. Charmaz (2014) recommended that coding be conducted using full semi-structured interview transcripts as this is the most holistic way to understand the data and not miss or misinterpret the data, and was the procedure used for data analyses.

The specific methodologies that were utilized within grounded theory were line-by-line coding and constant comparative methods (Charmaz, 2014). Coding in qualitative research is interpreting and defining the data. Line-by-line coding is reading over each line and coding the responses. In comparison, the constant comparative method is continuously comparing all sources of data against each other. Data were analyzed sequentially as follows:

1. Reviewed data throughout the data collection process.
2. Read and re-read all data as a whole per Maxwell's (2013) recommendation.
3. The author and an undergrad in the School of Kinesiology, Movement Science who had worked in the Child Movement, Activity, and Developmental Health Laboratory for three years separately engaged in independent coding informed by grounded theory. We first engaged in line-by-line coding and next employed the constant comparative method to develop initial and focused codes that were then categorized into analytic themes (these steps are iterative):
    - Engaged in initial coding via line-by-line coding
    - Developed initial codes
    - Developed focused codes
    - Developed analytic themes
4. Discrepancies between the two researchers' focused codes and themes were discussed and resolved.

5. Identified 29 focused codes that were classified into 7 analytical themes to draw conclusions and enhance understanding.
6. Triangulated interviews and home environment assessments, questionnaires, and assessments of motor competence and physical activity to verify data validity.
7. Prepared a of summary and descriptions of findings.

See table III.5 for how the home environment assessment and semi-structured interviews were integrated and the developed focused codes relevant to each research question for Aim 4. For each of the five questions asked on the home environment assessment, the author and undergraduate Kinesiology student examined if the responses aligned with the semi-structured interview responses.

Statistical Analyses for Mixed Methods. We adopted a mixed methods explanatory sequential design to further address Aim 4. Specifically, quantitative and qualitative findings were triangulated to clarify participants' beliefs about physical activity and motor competence in parents and children. Table III.6 summarizes how quantitative and qualitative data sources were combined for each research question. Data sources included questionnaires, physical activity data, motor competence data, home environment assessments, and interviews.

Research Question 1**: **What are parents' and children's knowledge about, perceptions of, and engagement with physical activity and motor competence? To examine parents' knowledge, perceptions, and engagement, we integrated the parent questionnaire, physical activity data, motor competence data, home environment assessment, and interviews. Questions from the parent questionnaire pertaining to parents' knowledge included the following (response options presented in parentheses): *Do you feel that there is a difference between physical activity and motor skills?* (yes or no); *How would you define physical activity?* (free response); and *How would you define motor skills?* (free response). The following questions were related to parents' perceptions: *How* *physically active would you categorize yourself?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Does your child meet the physical activity guidelines of obtaining 60 minutes of moderate to vigorous physical activity every day?* (yes or no); *How physically active would you say your child is?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Do you think your child is proficient at motor skills?* (not very proficient, not fairly proficient, neither not proficient nor proficient, fairly proficient, or very proficient); *Do you think your child needs to be more physically active?* (yes or no); and *Do you think your child needs improvements in their motor skills?* (yes or no). One item from this questionnaire was associated with engagement: *What type of vigorous (aerobic) physical activity or sports did you participate in at least twice per week during high school and during ages 18–22 years?* (free response).

To examine children's knowledge, perceptions, and engagement, the child questionnaire, physical activity data, motor competence data, home environment assessment, and interviews were integrated. No questions from the child questionnaire were relevant to knowledge or engagement. The following questionnaire items concerned perceptions (response options presented in parentheses): *Do you feel motor skills are important (i.e., being able to move your muscles/body different ways for sports or games)?* (yes or no); *Do you meet the physical activity guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity?* (yes or no); *How physically active would you categorize yourself?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Do you think you need to be more physically active?* (yes or no); and *Do you think you need to improve your motor skills?* (yes or no).

Research Question 2: What do parents and children identify as the benefits and barriers of physical activity? To examine parents' and children's benefits and barriers of physical activity the physical activity data, motor competence data, home environment assessment, and interviews were integrated. Neither the parent nor child questionnaire contained relevant items.

Research Question 3: How has COVID-19 affected parents' and children's physical activity and motor competence? To examine the impact of COVID-19 on parents, we integrated the parent questionnaire, physical activity data, motor competence data, and interviews. The following parent questionnaire items were considered: self-reported hours spent with one's child on weekdays and weekends before and during COVID-19; *How would you describe your child's physical activity during COVID-19?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Has your child been more active during COVID-19?* (yes or no); and *Since COVID-19, have you worked on improving your child's motor skills?* (yes or no). The Godin Leisure-Time Exercise Questionnaire was used to assess parents' physical activity during and before COVID-19. The PAQ

Triangulation was carried out by integrating the quantitative and qualitative data to make particular claims and assertions about participants' associations of and beliefs about motor competence and physical activity (Maxwell, 2013). During data analyses, the researcher examined the data sources for all participants and then focused on the 12 parents and children who participated in semi-structured interviews. Objective measurements of physical activity and motor competence, along with the selected 12 parent-child dyads' insights, clarified participants' associations of and beliefs about physical activity and motor competence.

Table III.5. Analyses strategy for each qualitative research question.

Research Questions	Semi-Structured Interview	Home Environment Assessment	Focused Codes
What are parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor competence?	Question 1-4	Questions 1-5	Parent knowledge PA & MS, child knowledge PA & MS, parent general, self, & other perceptions, child general, self & other perceptions, parent engagement, child engagement, family engagement, & space and equipment
What motivates parents and children to engage in physical activity and develop motor competence?	Question 4	--	Parent motivators, child motivators, family motivators
What are parents' perceived role in encouraging physical activity?	Question 5-7	--	Parents role for their children, parent's perceptions of others
What do parents and children identify as the benefits and barriers of physical activity?	Question 5-7	--	Parent barriers, child barriers, family barriers, parent benefits, child benefits, family benefits, parent's knowledge PA, child knowledge PA
How has COVID-19 affected parents' and children's physical activity and motor competence?	Question 4,5	--	Parent work status, child school status, Child PE class, COVID-19 activity level, COVID-19 barriers

Table III.6. Research questions by data sources matrix for mixed methods Aim 4.

RQs	Parent Questionnaires		Child Questionnaires	PA	MC	HEA	INT
What are parents' and children's knowledge about, perceptions of, and engagement in PA and motor competence?	Knowledge	• Do you feel that there is a difference between PA and motor skills? • How would you define PA? • How would you define motor skills?	--	--	--	--	✓
	Perceptions	• How physically active would you categorize yourself? • Does your child meet the PA guidelines of obtaining 60 minutes of moderate to vigorous physical activity every day? • How physically active would you say your child is? • Do you think your child is proficient at motor skills? • Do you think your child needs improvements in their motor skills?	• Do you feel motor skills are important (i.e., being able to move your muscles/body different ways for sports or games)? • Do you meet the PA guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity? • How physically active would you categorize yourself? • Do you think you need to improve your motor skills?	✓	✓	--	✓
	Engagement	• What type of vigorous (aerobic) PA or sports did you participate in at least twice per week during high school and during ages 18-22 years?	--	✓	✓	✓	✓
What do parents and children identify as the benefits and barriers of PA?	--		--	✓	✓	✓	✓
How has COVID-19 affected parents' and children's PA and motor competence?	• How would you describe your child's PA during COVID-19? • Has your child been more active during COVID-19? • Since COVID-19, have you worked on improving your child's motor skills?		PAQ-C during and before COVID-19	--	--	--	✓

	• The Godin Leisure-Time Exercise Questionnaire during and before COVID-19					

Note. RQs = research questions; PA= physical activity; MC = motor competence; HEA= home environment assessment; INT= semi-structured interviews.

Chapter IV Results

This study explored associations of and beliefs about physical activity, motor competence, and perceived competence in parents and children. This study's secondary was to explore the impact of COVID-19 on physical activity and motor competence. Aim 1 examined the associations between physical activity, motor competence, and perceived competence in parents and children. Aims 2 and 3 explored the associations between physical activity, motor competence, and perceived competence in parent-child dyads. Aim 4 investigated beliefs about physical activity and motor competence. This chapter begins with descriptive statistics of the participants for Research Aims 1–4. Each section is divided by research aim and presents the research questions, hypotheses, analyses, results with tables and/or figures, and an overall discussion of findings.

Data Cleaning and Software

All data were cleaned before analysis. Parents and children with incomplete data were removed from analysis for each research aim as applicable; see Table IV.1 for the final sample size of each research variable. Frequencies and descriptive statistics of sociodemographic characteristics, motor competence (including process and product scores), and physical activity (minutes per day) for parents and children were calculated to confirm that assumptions were met (e.g., linearity); see Table IV.2 for reported skewness and kurtosis values. All quantitative data analyses were performed in IBM SPSS Statistics (Version 27), and alpha levels were set to 0.05 a priori (Aims 1–3). All qualitative data were processed using NVivo 12 (QSR International, Doncaster, Australia), which simplified the sorting, coding, and analysis of data (Aim 4).

Table IV.1. Full list of sample size (n) for each research aim and question.

			Total
Aim 1	RQ 1	Parents	41
	RQ 2	Children	42
	RQ 3	Parents	42
		Children	39
Aim 2	RQ 1	Parents	48
		Children	48
	RQ 2	Parents	43
		Children	43
	RQ 3	Parents	49
		Children	49
Aim 3	RQ 1	Parents	40
		Children	40
Aim 4	RQs 1–3	Parents	12
		Children	12

Note. RQ = research question.

Table IV.2. Skewness and kurtosis values for main variables.

	N	Min.	Max.	Mean, SE	±Std. Dev.	Skewness, SE	Kurtosis, SE
Parent BMI	61	19.90	54.80	28.33, 0.88	6.90	1.44,0.31	2.54, 0.60
Child BMI	61	11.60	29.30	18.43, 0.52	4.07	0.69, 0.31	0.15, 0.60
Parent MVPA	50	16.72	105.1	50.55, 3.27	23.15	0.72, 0.34	0.32, 0.66
Child MVPA	48	14.45	93.86	47.48. 2.69	18.62	0.39, 0.34	-0.18, 0.67
Parent Motor Competence	43	-4.06	3.64	0.20,0.29	1.88	-0.37, 0.36	-0.40, 0.71
Parent Process Skills	46	-2.11	1.79	0.00,0.15	1.00	-0.17,0.35	-0.90, 0.69
Parent Product Skills	44	-3.34	2.63	0.08, 0.20	1.35	-0.82, 0.36	0.60, 0.70
Child Motor Competence	45	-5.58	4.60	0.08, 0.34	2.31	-0.68,0.35	0.15,0.70
Child Process Skills	48	-2.24	2.25	0.00, 0.14	1.00	0.00, 0.34	-0.50, 0.67
Child Product Skills	47	-3.60	2.35	-0.04, 0.23	1.57	-0.66, 0.35	-0.31, 0.68

Note. Min. = minimum; Max. = maximum; Std. Dev. = standard deviation; MVPA = moderate to vigorous physical activity; BMI = body mass index.

Participant Characteristics

A total of 76 parent-child dyads consented and assented to be part of this study. Fifteen parent-child dyads (19.7%) dropped out; reasons for attrition were no response, lack of time, and health issues. Sixty-one parent-child dyads completed at least one part of the study; see Table IV.3 for parents' sociodemographic characteristics, Table IV.4 for children's sociodemographic characteristics, and Figure IV.1 for participants' geographic location by zip code.

Table IV.3. Sociodemographic characteristics of parents.

	Overall % (*n* = 61)
Relationship to the child	
Mother	83.6
Father	16.4
Age	
20–29	1.6
30–39	47.5
40–49	47.5
50–59	3.3
Ethnicity	
White	88.5
Hispanic or Latino	1.6
Black or African American	3.3
Asian	1.6
Mixed ethnicity	4.9
Highest level of education	
High school degree or equivalent	1.6

Some college but no degree	11.5
Associate degree	4.9
Bachelor’s degree	29.5
Graduate degree or higher	52.5
Total number of adults in household	
1	6.6
2	88.5
3	4.9
4	0
≥ 5	0
Total household income	
≤ $24,999	9.8
$25,000–$49,999	9.8
$50,000–$99,999	34.4
$100,000–$149,999	23
≥ $150,000	23
Total number of children in household	
1	9.8
2	47.5
3	26.2
4	14.8
≥ 5	1.6
Weight classification	
Underweight	0
Normal	45.9
Overweight	24.6
Obese	29.5

Table IV.4. Sociodemographic characteristics of children.

	Overall % (*n* = 61)
Gender	
Female	59
Male	41
Age	
8	24.6
9	39.3
10	18
11	18
Ethnicity	
White	75.4
Hispanic or Latino	6.6
Black or African American	8.2
Asian	1.6
Mixed ethnicity	8.2
BMI classification	
Underweight	9.8
Normal	54.1
Overweight	16.4
Obese	19.7

Note. BMI = body mass index; BMI calculated based on CDC (2020).

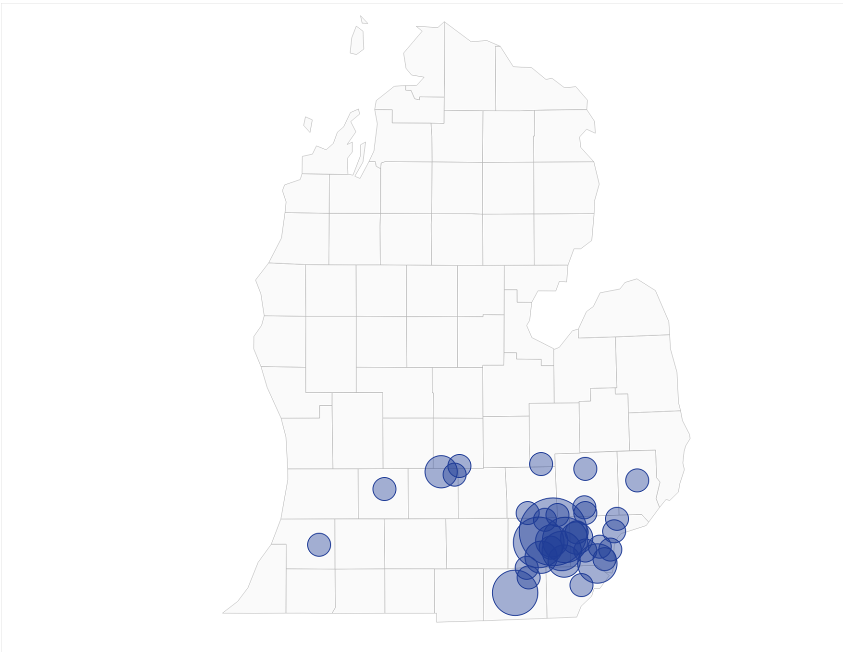


Figure IV.1. Participants' geographic location by zip code.

Physical Activity

Parents

Fifty parents had valid physical activity data; see Table IV.5 for descriptive statistics of these data by parents' gender and BMI classification (CDC, 2020). Independent samples *t*-tests were conducted to examine mean differences between females' and males' minutes per day spent in moderate to vigorous physical activity (MVPA) and in light, moderate, and vigorous activity. No statistically significant difference was observed for the means of minutes per day spent in MVPA or in light, moderate, and vigorous activity by gender. Analyses of variance (ANOVAs) were also performed to compare the means of minutes per day spent in MVPA and in light, moderate, and vigorous activity by BMI classification. No significant difference was found in BMI classification on minutes per day spent in MVPA or in light, moderate, or vigorous activity across healthy weight, overweight, or obese parents. Overall, parents were fairly active with a mean of 50.55 ± 23.15 MVPA minutes per day.

Children

Forty-eight children had valid physical activity data; see Table IV.6 for descriptive statistics of these data by children's gender and BMI classification (CDC, 2020). Independent samples *t*-tests were computed to examine mean differences between girls' and boys' minutes per day spent in MVPA and in light, moderate, and vigorous activity. No statistically significant difference was observed in means of minutes per day spent in MVPA and in light, moderate, and vigorous activity by gender. ANOVAs were also conducted to compare the means of minutes per day spent in MVPA and in light, moderate, and vigorous activity by BMI classification. No significant difference was found in BMI classification on means of minutes per day spent in MVPA or in light, moderate, or vigorous activity across underweight, healthy weight, overweight, or obese children. Overall, children in this study were fairly inactive: only 12 (25%) met the physical activity guideline to engage in 60 minutes of MVPA per day. Figure IV.2 displays a graphic representation of physical activity declining by age in children. Although no statistically significant difference emerged in means between ages in MVPA, children between 8 and 10 years of age showed a visual decline.

Table IV.5. Descriptive statistics of parents' minutes per day spent in physical activity.

Measure	N	Mean	±SD	Min. - Max.
MVPA (mins/day)	50	50.55	23.15	16.72 - 105.08
Gender				
Female	40	50.69	20.17	18.47 - 102.92
Male	10	49.98	33.98	16.72 - 105.08
BMI				
Normal	25	56.98	25.45	21.42 - 105.08
Overweight	12	43.42	17.12	16.72 - 75.41
Obese	12	44.87	21.56	18.47 - 77.55

LPA (mins/day)	50	83.44	25.84	43.53 - 142.02
Gender				
Female	40	84.47	25.35	44.79 - 142.02
Male	10	79.31	28.75	43.53 - 131.72
BMI				
Healthy	25	83.42	21.40	52.43 - 120.82
Overweight	12	90.49	33.05	46.42 - 142.02
Obese	12	75.83	25.72	43.53 - 105.86
MPA (mins/day)	50	45.06	20.61	15.69 - 97.42
Gender				
Female	40	44.87	17.54	16.43 - 88.28
Male	10	45.82	31.31	15.69 - 97.42
BMI				
Normal	25	51.14	22.83	20.70 - 97.42
Overweight	12	39.88	15.83	15.69 - 69.27
Obese	12	38.02	17.68	16.43 - 65.11
VPA (mins/day)	50	5.49	4.29	0.72 - 20.91
Gender				
Female	40	5.82	4.43	1.05 - 20.91
Male	10	4.16	3.59	0.72 - 11.29
BMI				
Healthy	25	5.85	4.14	0.72 - 14.64
Overweight	12	3.54	1.70	1.03 - 6.14
Obese	12	6.85	5.89	1.38 - 20.91

Note. Min. = minimum; Max. = maximum; PA = physical activity; L = light; M = moderate; V = vigorous; MV = moderate to vigorous; BMI = body mass index.

Table IV.6. Descriptive statistics of children's minutes per day spent in physical activity.

Measure	N	Mean	±SD	Min. – Max.
MVPA (mins/day)	48	47.48	18.62	14.45 – 93.86
Gender				
Female	31	46.88	19.65	14.45 – 93.86
Male	17	48.57	17.21	16.51 – 79.80
BMI				
Underweight	4	48.38	26.19	23.25 – 85.12
Normal	28	49.18	20.69	14.45 – 93.86
Overweight	8	43.68	18.23	21.41 – 71.14
Obese	8	44.95	3.85	38.21 – 48.59
LPA (mins/day)	48	100.99	31.06	43.01 – 232.12
Gender				
Female	31	98.38	34.01	43.01 – 232.12
Male	17	105.73	25.07	51.29 – 142.27
BMI				
Underweight	4	90.35	30.09	51.18 – 115.06
Healthy	28	105.79	37.60	43.01 – 232.12

Overweight	8	94.00	12.37	76.67 – 108.93
Obese	8	96.47	15.79	72.26 – 118.40
MPA (mins/day)	48	25.33	8.86	7.39 – 46.03
Gender				
Female	31	24.82	9.04	7.39 – 46.03
Male	17	26.25	8.70	8.64 – 44.15
BMI				
Underweight	4	24.03	9.28	11.64 – 34.03
Healthy	28	25.46	10.37	7.39 – 46.03
Overweight	8	24.13	7.67	15.82 – 36.11
Obese	8	26.72	3.38	23.28 – 32.00
VPA (mins/day)	48	22.15	11.67	0.00 – 54.95
Gender				
Female	31	22.06	13.04	0.00 – 54.95
Male	17	22.31	9.00	7.51 – 36.07
BMI				
Underweight	4	24.36	18.05	11.60 – 51.09
Normal	28	23.73	12.34	7.07 – 54.95
Overweight	8	19.55	11.60	0.00 – 36.07
Obese	8	18.13	3.64	13.43 – 23.61

Note. Min. = minimum; Max. = maximum; PA = physical activity; L = light; M = moderate; V = vigorous; MV = moderate to vigorous; BMI = body mass index.

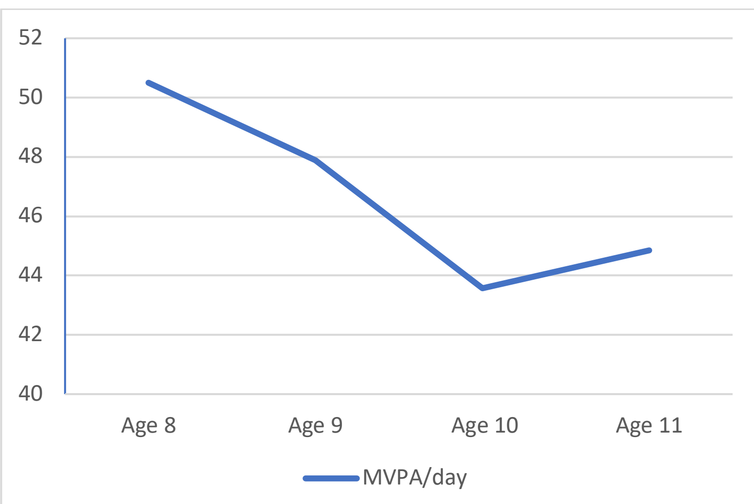


Figure IV.2. Minutes per day of MVPA by age in children.

Motor Competence

Parents

A total of 43 parents had a computed motor competence score, 46 parents completed process measures, 49 parents completed catch percentage, and 44 parents completed maximum jump distance. Table IV.7 lists the descriptive statistics of parents' motor competence scores, process measures, catch percentage, and maximum jump distance by gender and BMI classification (Centers for Disease Control and Prevention [CDC], 2020). Independent samples *t*-tests were computed to examine mean differences between females and males on motor competence scores, process measures, catch percentage, and maximum jump distance. No statistically significant difference appeared motor competence scores, process measures, or catch percentage by gender. A statistically significant difference was observed for maximum jump distance ($M = 108.68 \pm 40.95$) between females ($M = 100.28 \pm 36.92$) and males ($M = 146.50 \pm 38.61$); [$t(10.01) = -3.09$, $p = 0.011$], equal variances not assumed. ANOVAs were also conducted to compare motor competence scores, process measures, catch percentage, and maximum jump distance by BMI classification. There was a significant difference in BMI classification on motor competence across healthy weight, overweight, and obese parents [$F(2,40) = 4.41$, $p = 0.019$]. Post hoc comparisons using the Bonferroni test indicated that the mean score for healthy weight parents ($M = 0.87 \pm 1.83$) differed significantly from that for overweight parents ($M = -0.73 \pm 1.35$). However, obese parents ($M = -0.72 \pm 1.97$) did not differ significantly from healthy weight or overweight parents. No significant difference was found in BMI classification on process skills in healthy weight, overweight, or obese parents [$F(2,43) = 2.84$, $p = .07$]. There was a significant difference in BMI classification on catch percentage among healthy weight, overweight, and obese parents [$F(2,46) = 3.21$, $p = 0.049$]. Post hoc comparisons using the Bonferroni test indicated that the mean score for healthy weight parents ($M = 99.23 \pm 3.92$) differed significantly from that of obese parents (*M* = 93.33 ± 9.85). However, overweight parents (*M* = 96.36 ± 8.09) did not differ significantly from healthy weight or obese parents. There was also a significant difference in BMI classification on maximum jump distance in healthy weight, overweight, and obese parents [$F(2,41) = 4.48$, $p = .017$]. Post hoc comparisons using the Bonferroni test indicated that the mean score for healthy weight parents (M= 122.92 ± 39.84) differed significantly from that of overweight parents (*M* = 83.18 ± 41.88). By comparison, obese parents (*M* = 99.25 ± 22.54) did not differ significantly from healthy weight or overweight parents.

Children

Forty-five children had a computed motor competence score, 48 children completed process measures, 49 children completed catch percentage, and 47 children completed maximum jump distance; see Table IV.8 for the descriptive statistics of children's motor competence scores, process measures, catch percentage, and maximum jump distance by gender and BMI classification (CDC, 2020). Independent samples *t*-tests were performed to examine mean differences between girls and boys on motor competence scores, process measures, catch percentage, and maximum jump distance. No statistically significant difference was observed in motor competence scores or catch percentage by gender. A statistically significant difference was identified in process skills (*M* = 16.98 ± 4.91) between girls (*M* = 15.76 ± 4.18) and boys (*M* = 18.84 ± 5.44); [$t(46) = -2.22$, $p = 0.032$]. Furthermore, a statistically significant difference was found for maximum jump distance (*M* = 103.36 ± 29.62) between girls (*M* = 95.41 ± 30.97) and boys (*M* = 114.10 ± 24.48); [$t(45) = -2.23$, $p = 0.031$]. ANOVAs were carried out to compare motor competence scores, process measures, catch percentage, and maximum jump distance by BMI classification. There was no significant difference of BMI classification on motor competence in underweight, healthy weight, overweight, or obese children [$F(3,41) = 0.12$, $p = 0.946$]. No significant difference appeared in BMI classification on process skills in underweight, healthy weight, overweight, or obese children [$F(3,44) = 0.71$, $p = .552$]. Similarly, there were no significant differences of BMI classification on catch percentage among underweight, healthy weight, overweight, or obese children [$F(3,45) = 0.28$, $p = 0.84$] or of BMI classification on maximum jump distance among underweight, healthy weight, overweight, or obese children [$F(3,45) = 0.54$, $p = 0.66$].

Table IV.7. Descriptive statistics of parents' motor competence, process score, max jump, and catch percentage.

Measure	N	Mean	±SD	Min. - Max.
Motor Competence	43	0.20	1.88	-4.06 - 3.64
Gender				
Female	36	-0.01	1.80	-4.06 - 2.88
Male	7	1.29	2.08	-2.34 – 3.64
BMI				
Healthy	25	0.87	1.83	-3.58 - 3.64
Overweight	11	-0.73	1.35	-3.38 - 0.71
Obese	8	-0.72	1.97	-4.06 - 2.12
Process	46	19.83	5.14	9.00 - 29.00
Gender				
Female	39	19.49	5.14	9.00 - 29.00
Male	7	21.71	5.06	11.00 - 25.00
BMI				
Normal	26	21.00	4.16	12.00 - 27.00
Overweight	11	19.82	5.53	11.00 - 28.00
Obese	9	16.44	6.25	9.00 - 29.00
Catch Percentage	49	97.14	7.07	80.00 - 100.00
Gender				
Female	41	97.56	6.63	80.00 - 100.00
Male	8	95.00	9.26	80.00 - 100.00
BMI				
Healthy	26	99.23	3.92	80.00 - 100.00
Overweight	11	96.36	8.09	80.00 - 100.00
Obese	12	93.33	9.85	80.00 - 100.00
Max. Jump Distance (cm)	44	108.68	40.95	0.00 - 160.00
Gender				
Female	36	100.28	36.92	0.00 - 160.00
Male	8	146.50	38.61	71.0 - 200.00
BMI				
Normal	25	122.92	39.84	0.00 - 200.00
Overweight	11	83.18	41.88	0.00 - 142.00
Obese	8	99.25	22.54	72.00 - 147.00

Note. SD = standard deviation; Min. = minimum; Max. = maximum; BMI = body mass index.

Table IV.8. Descriptive statistics of children's motor competence, process scores, max jump, and catch percentage.

Measure	N	Mean	±SD	Min. - Max.
Motor Competence	45	0.08	2.31	-5.58 - 4.60
Gender				
Female	26	-0.29	2.13	-5.41 - 2.97
Male	19	0.58	2.51	-5.58 - 4.60
BMI				
Underweight	3	0.03	1.84	-2.08 - 1.31
Healthy	27	0.14	2.64	-5.58 - 4.60
Overweight	7	0.33	2.17	-3.37 - 2.73
Obese	8	-0.36	1.49	-2.66 - 1.86
Process	48	16.98	4.91	6.00 - 28.00
Gender				
Female	29	15.76	4.18	8.00 - 24.00
Male	19	18.84	5.44	6.00 - 28.00
BMI				
Underweight	3	14.00	3.61	10.00 - 17.00
Normal	28	17.64	5.30	6.00 - 28.00
Overweight	8	17.13	5.33	11.00 - 24.00
Obese	9	15.78	3.46	11.00 - 23.00
Catch Percentage	49	82.86	26.77	0.00 - 100.00
Gender				
Female	29	87.59	19.58	20.00 - 100.00
Male	49	76.00	34.09	0.00 - 100.00
BMI				
Underweight	3	93.33	11.55	80.00 - 100.00
Healthy	28	80.71	30.05	0.00 - 100.00
Overweight	8	87.50	18.32	60.00 - 100.00
Obese	10	82.00	27.41	20.00 - 100.00
Max. Jump Distance (cm)	47	103.36	29.62	0.00 - 154.00
Gender				
Female	27	95.41	30.97	0.00 - 136.00
Male	20	114.10	24.48	075.00 - 154.00
BMI				
Underweight	3	110.67	20.50	87.00 - 123.00
Normal	28	106.00	33.36	0.00 - 154.00
Overweight	7	103.86	26.38	65.00 - 131.00
Obese	9	92.33	21.88	0.00 - 154.00

Note. SD = standard deviation; Min. = minimum; Max. = maximum; BMI = body mass index.

Perceived Competence

A total of 57 parents completed the perceived competence part of the parent questionnaire, and 49 children completed the perceived competence part of the child questionnaire. Table IV.9 displays descriptive statistics for the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) for parents and children.

Table IV.9. Descriptive statistics for domains of perceived competence.

Domain	Parent (n = 57)		Child (n = 49)	
	M	±SD	M	±SD
Athletic competence	2.32	0.80	2.83	0.76
Physical appearance	2.62	0.71	3.09	0.68
Global self-worth	3.08	0.55	3.13	0.47

Note: M = mean; SD = standard deviation. Scale of 1–4 points.

Home Environment Assessment and Semi-structured Interviews

Through purposeful sampling, 12 parent-child dyads completed the home environment assessment and semi-structured interviews. Table IV.10 lists the descriptive characteristics of these 12 dyads; see Table IV.11 for dyads' BMI classification, physical activity classification, and motor competence classification. Physical activity was defined as the percentage of time per day spent in MVPA (1–4% = low, 5–8% = medium, 9–12% = high). Motor competence was defined as process skills; in this study, a range of 1–10 was considered low, 11–20 was medium, and 21–30 was high.

Table IV.10. Descriptive statistics of Phase 3 participants.

Family	Income	Education	Occupation	# Adults	# Children	Parent Ethnicity	Child Ethnicity	Parent Age	Child Age	Child Gender
Smith	$25k–$49k	Some college	Service and sales workers	1	4	White	Biracial Black & White	31	12	Female
Jones	$50k–$99k	Associate's	Technicians & associate professors	2	2	White	White	45	9	Male
Miller	$50k–$99k	Master's or higher	Professionals	2	2	White	White	45	11	Female
Williams	$25k–$49k	Some college	Service and sales workers	2	5	White	White	31	9	Female
Johnson	>$150k	Master's or higher	Technicians & associate professors	2	3	White	White	41	11	Male
Brown	$50k–$99k	Master's or higher	Technicians & associate professors	2	2	White	White	45	9	Female
Davis	>$150k	Master's or higher	Professionals	2	2	White	White	43	11	Male
Thomas	$100k–$149k	Associate's	Professionals	2	2	White	White	39	10	Male
Lee	>$150k	Bachelor's	Managers	2	2	White	White	42	11	Male
Martin	>$150k	Master's or higher	Professionals	2	3	White	White	50	11	Male
Anderson	<$24k	Some college	Technicians & associate professors	1	3	Black	Black	34	11	Female
Taylor	<$24k	Bachelor's	Technicians & associate professors	2	4	White	White	46	11	Female

Note. Pseudonyms have been used. Occupations were categorized using the ISCO International Standard Classification of Occupations (stay-at-home parents were classified as service and sales workers, as they are childcare workers); # of adults in the home; # of children in the home.

Table IV.11. Body mass index, physical activity, and motor competence classifications for Phase 3 participants.

Family	Parent BMI	Child BMI	Parent MVPA	Child MVPA	Parent Process Skills	Child Process Skills
Smith	Normal	Normal	Medium	Low	Medium	Medium
Jones	Obese	Obese	Medium	Medium	Medium	Medium
Miller	Normal	Underweight	Low	Medium	High	Low
Williams	Overweight	Normal	Medium	Medium	Medium	Medium
Johnson	Normal	Normal	High	Medium	Medium	Medium
Brown	Normal	Normal	Low	Medium	High	Medium
Davis	Obese	Normal	Medium	Low	Medium	High
Thomas	Normal	Normal	Low	Low	High	High
Lee	Overweight	Normal	Low	Low	High	High
Martin	Normal	Overweight	Medium	High	High	High
Anderson	Obese	Obese	--	--	Low	Medium
Taylor	Normal	Overweight	Medium	Low	High	Medium

Note. BMI = body mass index; MVPA = moderate to vigorous physical activity; physical activity defined as % in MVPA per day (1–4 = low, 5–8 = medium, 9–12 = high); process skills: 1–10 = low, 11–20 = medium, = 21–30 high. No physical activity data were available for the Anderson family.

Research Aim 1

Research Question 1

What is the association between parents' motor competence and physical activity?

Hypothesis 1: Parents' motor competence will have a moderately positive association with physical activity.

Statistical Analysis

Partial bivariate correlations were conducted to examine the association of parents' motor competence and physical activity, controlling for BMI and gender. Data were next analyzed using ordinary least squares (OLS) multiple linear regressions. Physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous minutes of activity) served as the outcome variable; motor competence was the predictor variable; and BMI and gender were added to the models as control variables.

Due to the known bi-directional relationship between motor competence and physical activity, OLS multiple linear regression models were created with motor competence as the outcome variable; physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) as the predictor variable; and BMI and gender as control variables. There were no significant differences between the models with physical activity and motor competence as outcome variables; therefore, only models containing physical activity were presented.

Results

Descriptive statistics. A total of 41 parents were included in partial bivariate correlations and OLS multiple linear regressions. The mean of MVPA was 54.68 ± 22.33 minutes per day, that of light physical activity was 85.92 ± 25.34 minutes per day, that of moderate physical activity was 48.75 ± 19.99 minutes per day, and that of vigorous physical activity was 5.93 ± 4.45 minutes per day. The mean of motor competence was 0.38 ± 1.74.

Physical activity. Partial bivariate correlations were calculated between motor competence and domains of physical activity (MVPA and light, moderate, and vigorous activity) while controlling for BMI and gender. No significant correlations manifested between motor competence and any of the physical activity domains: MVPA (r = -0.25), light (r = -0.15), moderate (r = -0.30), or vigorous (r = 0.08).

Then, OLS multiple linear regressions were calculated to predict physical activity (MVPA and light, moderate, and vigorous activity) based on motor competence, controlling for BMI and gender. None of the domains of physical activity (MVPA and light, moderate, and vigorous activity) were associated with motor competence (ps > 0.05; see Table IV.12).

Table IV.12. Predictors of change for parents' physical activity.

		Baseline					BMI					BMI & Gender				
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
MVPA	Intercept	55.3	3.6	<0.001	0.02		84.6	18.9	<0.001	0.08	0.06	69.4	21.8	0.003	.12	0.05
	MC	-1.6	2.0	0.435			-2.8	2.1	0.20			-3.4	2.2	0.121		
	BMI						-1.1	0.70	0.125			-1.1	0.70	0.127		
	Gender											12.8	9.3	0.178		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Light	Intercept	86.2	4.1	<0.001	0.00		118.7	21.7	<0.001	0.06	0.06	110.5	25.4	<0.001	0.07	0.01
	MC	-0.6	2.3	0.790			-1.9	2.50	0.433			-2.29	2.53	0.371		
	BMI						-1.2	0.80	0.136			-1.21	0.81	0.143		
	Gender											6.86	10.9	0.532		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Moderate	Intercept	49.4	3.20	<0.001	0.02		78.68	16.8	<0.001	0.10	0.08	62.19	19.0	0.002	0.16	0.07
	MC	-1.8	1.82	0.338			-2.95	1.89	0.127			-3.90	1.84	0.061		
	BMI						-1.10	0.62	0.084			-1.08	0.60	0.082		
	Gender											13.85	8.13	0.097		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Vigorous	Intercept	5.87	0.72	<0.001	0.00		5.89	3.93	0.142	0.00	0.00	7.16	4.60	0.129	0.01	0.01
	MC	0.16	0.41	0.706			0.16	0.44	0.729			0.14	0.45	0.651		
	BMI						-0.00	0.14	0.995			-0.00	0.14	0.987		
	Gender											-1.06	1.97	0.592		

Note. BMI = body mass index; MC = motor competence; MVPA = moderate to vigorous physical activity.

Research Question 2

What is the association between children's motor competence and physical activity?

Hypothesis 2: Children's motor competence will have a strong positive association with physical activity.

Statistical Analysis

Partial bivariate correlations were conducted to examine the association between children's motor competence and physical activity, controlling for BMI and gender. Data were then analyzed using OLS multiple linear regressions. Physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as the outcome variable; motor competence was the predictor variable; and BMI and gender were added to the models as control variables.

Due to the established bi-directional relationship between motor competence and physical activity, OLS multiple linear regression models were constructed with motor competence as the outcome variable; physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) represented the predictor variable; and BMI and gender were control variables. No significant differences emerged between models with physical activity and motor competence as outcome variables; as such, only the models in which physical activity served as the outcome variable are presented.

Results

Descriptive statistics. Forty-two children were included in partial bivariate correlations and OLS multiple linear regression. The mean of MVPA was 48.31 ± 17.24 minutes per day, that of light physical activity was 104.04 ± 29.73 minutes per day, that of moderate physical activity was 26.12 ± 8.31 minutes per day, and that of vigorous physical activity was 22.20 ± 10.98 minutes per day. The mean of motor competence was 0.20 ± 2.19.

Physical activity. Partial bivariate correlations were computed between motor competence and the domains of physical activity (minutes per day spent in MVPA and light, moderate, and vigorous activity), controlling for BMI and gender. No significant correlations were observed between motor competence and any physical activity domains: MVPA (r = 0.00), light (r = -0.08), moderate (r = 0.04), or vigorous (r = -0.02).

Next, OLS multiple linear regressions were calculated to predict physical activity (MVPA and light, moderate, and vigorous activity) based on motor competence while controlling for BMI and gender. None of the domains of physical activity (MVPA and light, moderate, and vigorous activity) were associated with motor competence (ps > 0.05; see Table IV.13).

Table IV.13. Predictors of change for children's physical activity.

		Baseline					BMI					BMI & Gender				
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
MVPA	Intercept	48.2	2.70	<0.001	0.00		74.8	13.7	<0.001	0.09	0.09	74.9	14.1	<0.001	0.09	0.00
	MC	0.35	1.24	0.780			0.03	1.21	0.984			0.034	1.28	0.979		
	BMI						-1.45	0.73	0.055			-1.45	0.74	0.059		
	Gender											-0.14	5.67	0.980		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Light	Intercept	104	4.66	<0.001	0.00		155	23.4	<0.001	0.11	0.11	154.6	24.1	<0.001	0.11	0.00
	MC	-0.3	2.15	0.885			-0.94	2.06	0.653			-1.01	2.18	0.645		
	BMI						-2.78	1.25	0.032			-2.77	1.27	0.035		
	Gender											1.21	9.66	0.901		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Moderate	Intercept	26.1	1.30	<0.001	0.00		33.89	6.81	<0.001	0.04	0.03	34.0	7.02	<0.001	0.04	0.01
	MC	0.23	0.60	0.703			0.14	0.60	0.824			0.049	0.63	0.814		
	BMI						-0.43	0.36	0.250			-0.43	0.37	0.255		
	Gender											-0.25	2.81	0.930		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Vigorous	Intercept	22.2	1.72	<0.001	0.00		40.9	8.9	<0.001	0.11	0.11	40.9	8.90	<0.001	0.11	0.00
	MC	0.12	0.79	0.881			-0.11	0.76	0.886			-0.12	0.81	0.886		
	BMI						-1.02	0.46	0.033			-1.02	0.47	0.035		
	Gender											0.11	3.57	0.977		

Note. BMI = body mass index; MC = motor competence; MVPA = moderate to vigorous physical activity.

Research Question 3

Does perceived competence partially mediate the association between motor competence and physical activity in the parent and children models?

Hypothesis 3: Perceived competence will be a partial mediator between physical activity and motor competence for parents and children.

Statistical Analysis

No statistically significant association was found between motor competence and physical activity in the parent or children models; thus, mediation could not be calculated. Bivariate correlations and OLS linear regressions were computed. In the first set of linear regressions, motor competence was the outcome variable, and the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) served as predictor variables. In the second set of models, physical activity (defined as minutes per day of MVPA) was the outcome variable and the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were taken as predictor variables. Both bivariate OLS linear regressions were examined in parents and children.

Results

Descriptive statistics. In total, 42 parents were included in bivariate correlations and OLS linear regressions for motor competence. For parents, the mean of motor competence was 0.27 ± 1.85, that of athletic competence was 2.32 ± 0.82, that of physical appearance was 2.74 ± 0.67, and that of global self-worth was 3.10 ± 0.50. Thirty-nine children were included in bivariate correlations and OLS linear regressions for motor competence; their mean of motor competence was -0.03 ± 2.40. Additionally, for children, the mean of athletic competence was 2.7 ± 0.61, that of physical appearance was 3.10 ± 0.61, and that of global self-worth was 3.10 ± 0.47.

Fifty parents were included in the bivariate correlations and OLS linear regressions for physical activity. Their mean of MVPA was 50.55 ± 23.15 minutes per day, that of athletic competence was 2.37 ± 0.83, that of physical appearance was 2.67 ± 0.71, and that of global self-worth was 3.15 ± 0.49. In total, 42 children were included in the bivariate correlations and OLS linear regressions for physical activity. Their mean of MVPA was 48.20 ± 19.18 minutes per day, that of athletic competence was 2.74 ± 0.61, that of physical appearance was 3.16 ± 0.60, and that of global self-worth was 3.15 ± 0.46.

Motor competence. A bivariate correlation was conducted for parents between each domain of perceived competence (i.e., athletic competence, physical appearance, global self-worth) and motor competence. The variables of athletic competence and motor competence showed a weak but significant correlation, $r(40) = 0.34$, $p = .02$ (Evans, 1996). No association was identified between the perceived competence domains of physical appearance and global self-worth to motor competence ($r = 0.16$ and $r = 0.08$, respectively). Next, bivariate OLS linear regressions were calculated to predict motor competence based on the three domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth). A positive significant regression association was observed between the domain of athletic competence and parents' motor competence ($\beta = 0.76 \pm 0.34$; $p = 0.030$): for each one-unit increase in athletic competence, parents' motor competence demonstrated a 0.76-unit increase. Associations between parents' motor competence and the perceived competence domains of physical appearance and global self-worth were non-significant (ps > 0.05; see Table IV.14).

For children, bivariate correlations were calculated between each domain of perceived competence (i.e., athletic competence, physical appearance, global self-worth) and motor competence. Athletic competence and motor competence had a weak but significant correlation, $r(37) = 0.31$, $p = 0.03$ (Evans, 1996). The associations of physical appearance and global self-worth to motor competence were non-significant ($r = 0.03$ and $r = 0.04$, respectively). Bivariate OLS regressions were then calculated to predict motor competence based on the three domains of perceived competence: athletic competence, physical appearance, and global self-worth. The association between the domain of athletic competence and children's motor competence was approaching significance ($\beta = 1.22 \pm 0.61$; $p = 0.054$). For each one-unit increase in athletic competence, children's motor competence increased by 1.22. The association between motor competence and the perceived competence domains of physical appearance and global self-worth were non-significant (*p*s > 0.05; see Table IV.15).

Table IV.14. Predictors of parents' motor competence.

		b	SE	*p*	R^2
MC	Intercept	-1.485	0.826	0.080	.113
	AC	0.758	0.336	**0.030***	
MC	Intercept	-0.963	1.213	0.432	0.027
	PA	0.451	0.430	0.301	
MC	Intercept	-0.650	1.82	0.724	0.001
	SW	0.298	0.581	0.611	

Note. AC = athletic competence PA = physical appearance; SW = global self-worth; MC = motor competence; *$p < 0.05$.

Table IV.15. Predictors of change for children's motor competence.

		b	SE	*p*	R^2
MC	Intercept	-3.316	1.691	0.057	.097
	AC	1.216	0.610	**0.054**	
MC	Intercept	-0.370	2.069	0.859	0.00
	PA	0.109	0.647	0.867	
MC	Intercept	-0.615	2.662	0.819	0.00

SW	0.188	0.840	0.824

Note. AC = athletic competence PA = physical appearance; SW = global self-worth; MC = motor competence.

Physical activity. For parents and children, a bivariate correlation was conducted between each domain of perceived competence (i.e., athletic competence, physical appearance, global self-worth) and physical activity defined as minutes per day of MVPA. For parents, no association was found between any of the domains of perceived competence and MVPA (athletic competence r = .18, physical appearance r = .02, and global self-worth r = .17). For children, there was no association between any of the domains of perceived competence and MVPA (athletic competence r = .01, physical appearance r = .18, and global self-worth r = .06).

Next, OLS linear regressions were calculated to predict MVPA based on the three domains of perceived competence: athletic competence, physical appearance, and global self-worth. The association between parents' and children's MVPA and the domains of athletic competence, physical appearance, and global self-worth were non-significant (ps > 0.05; see Table IV.16 and Table IV.17).

Table IV.16. Predictors of change for parents' physical activity.

		b	SE	*p*	R^2
MVPA	Intercept	38.78	9.95	<0.001	0.03
	AC	4.97	3.97	0.216	
MVPA	Intercept	49.15	13.02	<0.001	0.00
	PA	0.53	4.72	0.912	
MVPA	Intercept	25.47	21.33	0.238	0.029
	SW	7.95	6.67	0.240	

Note. AC = athletic competence PA = physical appearance; SW = global self-worth; MC = motor competence.

Table IV.17. Predictors of change for children's physical activity.

		b	SE	*p*	R²
MVPA	Intercept	47.26	14.05	0.002	0.00
	AC	0.341	5.00	0.946	
MVPA	Intercept	30.37	16.10	0.067	0.03
	PA	5.65	5.02	0.267	
MVPA	Intercept	40.19	20.79	0.060	0.00
	SW	2.55	6.54	0.699	

Note. AC = athletic competence PA = physical appearance; SW = global self-worth; MC = motor competence.

Discussion

Association of Motor Competence and Physical Activity

In examining the association between motor competence and physical activity in parents, we hypothesized that parents' motor competence would have a moderately positive association with physical activity based on the models of Stodden et al. (2008), Robinson et al. (2015a), and Hulteen et al. (2018). This hypothesis was not supported; we found no association between parents' motor competence and physical activity. To the author's knowledge, only two other studies have examined the association between motor competence and physical activity in adults (Cantell et al., 2008; Sackett & Edwards, 2019). In line with our findings, Cantell et al. (2008) and Sackett and Edwards (2019) did not identify a positive association between adults' motor competence and physical activity. Both Cantell et al. (2008) and Sackett and Edwards (2019) used self-report measures of physical activity. This study adopted an objective measurement of physical activity (i.e., accelerometers), but the findings were similar: no significant association was observed between parents' motor competence and physical activity. Motor competence may not be related to physical activity, as argued by Sackett and Edwards (2019). The findings of the current study do not support the conceptual models in motor development or the idea that the association between motor competence and physical activity tracks into adolescence, and potentially into adulthood, as postulated (Barnett et al., 2008; Jaakkola et al., 2016; Lima et al., 2017; Venetsanou & Kambas, 2017).

Few scholars have examined motor competence in adults, specifically FMS (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013). Given a lack of relevant studies, no validated or reliable assessment of motor competence for adults is currently available. Researchers, including in this study, have instead used assessments validated with children (Hands et al., 2015). Our study applied the process measurement Test of Gross Motor Development (TGMD)-3 (Ulrich, 2019), which has been validated in children up to age 10 but has also been used in adult studies (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). Our study included the product measurement of catch percentage and jump distance as well; this measure has mainly been used in preschool studies (Palmer et al., 2020, 2021; Robinson et al., 2020) with children between ages 4 and 13 (Stodden et al., 2014) and one study with young adults (Stodden et al., 2009, 2013). Even though using a combination of process and product measures is considered best practice in motor competence research, the absence of validated or reliable measures for adults makes it challenging to evaluate these individuals' motor competence.

Regarding the association between motor competence and physical activity in children, we hypothesized that children's motor competence would have a strong positive association with physical activity based on the conceptual models of Stodden et al. (2008), Robinson et al. (2015a), and Hulteen et al. (2018). This hypothesis was not supported, as we observed no association between children's motor competence and physical activity. The findings of this study thus do not support conceptual models in motor development (Hulteen et al., 2008; Robinson et al., 2015a;

Stodden et al., 2008) or the extensive research indicating a positive and significant association between motor competence and physical activity in children (Holfelder & Schott, 2014; Logan et al., 2015; Lubans et al., 2010), which has been found to track into adolescence (Jaakkola et al., 2016; Lima et al., 2017; Venetsanou & Kambas, 2017). Significant limitations of this dissertation study may have led to these non-significant findings in parents and children.

Limitations were based on this study being moved online. No assessments are currently available to measure motor competence or perceived competence remotely. This study is the first to evaluate motor competence using participant-recorded and -uploaded videos to the author's knowledge. The author and experts in the kinesiology field developed a motor competence assessment that parents and children could complete at home. This assessment used validated process (TGMD-3; Ulrich, 2019) and product (Haubenstricker & Branta, 1997; Palmer et al., 2020; Stodden et al., 2014) measures. However, there were constraints to the online motor competence assessment; the instrument may not have captured parents' and children's actual motor competence. Only four process and two product skills were included in the assessment. Therefore, six measurements were combined to develop an overall motor competence score. In addition, the four motor skills did not fully assess FMS domains, as only one locomotor and three ball skills were included. Another limitation of the online motor competence assessment involved administration. First, it was impossible to determine whether participants had followed directions. Motor competence assessments (including the validated assessments used in this study) are generally administered by trained researchers (Logan et al., 2018); however, parents and children self-administered the online motor competence assessment for this study. It was thus impossible to assess whether parents and children had accurately followed the administration sequence (i.e., watch the multimedia demonstration, complete one practice trial, re-watch the multimedia demonstration, and then complete test trials). This sequence was developed based on the standard protocol for administering the TGMD-3 (Ulrich, 2020) and has been adopted when evaluating product and process skills (Palmer et al., 2020; Robinson et al., 2020). If parents and children did not follow this sequence, data validity may have been further threatened. Second, the quality of motor skill videos varied. Participants did not always follow the filming directions. For example, many videos followed the ball rather than the participant's body, making coding challenging. Future research could examine the quality of submitted motor skill videos.

In terms of perceived competence, the author transferred validated assessments (i.e., The Self-Perception Profile for Adults and Children) to the online platform Qualtrics (Qualtrics, Provo, UT). However, the platform was not ideal for these assessments. The Self-Perception Profile for Adults and Children is presented in a four-choice structured-alternative format (Messer & Harter, 2012; Harter, 2012). This configuration was not fully compatible with online administration. Four parents and 10 children who filled out the questionnaire did not complete the perceived competence section correctly. There was no way to determine whether parents and children who completed the perceived competence assessment understood the format. These errors may have affected the perceived competence variable.

No motor skill or perceived competence assessment has yet been standardized for remote or online administration. This study hence piloted the administration of a motor competence and perceived competence assessment remotely and online. This method may have influenced parents' and children's actual motor competence and perceived competence scores.

Perceived Competence as a Mediator

Although it was hypothesized that perceived competence would serve as a partial mediator between motor competence and physical activity in parents and children, the results of this study did not provide evidence for the mediating role of perceived competence. This hypothesis was therefore not supported. The finding that perceived competence was not a mediator does not support conceptual models in motor development (Hulteen et al., 2008; Robinson et al., 2015a; Stodden et al., 2008). Mediation has not been examined in adults; in children, our finding does not align with studies indicating perceived competence as a mediator (Barnett et al., 2008, 2011; Khodaverdi et al., 2015). It is important to note that both Stodden et al. (2008) and Robinson et al. (2015a) discussed preliminary evidence of mediation but stated that researchers should further examine the role of perceived competence. Bivariate OLS linear regressions were conducted to investigate the association between (1) perceived competence and motor competence and (2) perceived competence and physical activity.

We found a significant and positive association between the perceived competence domains of athletic competence and motor competence in parents. This pattern is supported by previous studies investigating perceived competence in young adults (De Meester et al., 2020; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). De Meester et al. (2020) performed a systematic review and meta-analysis between perceived motor competence and motor competence and found a weak but significant association. Two studies have examined perceived competence using the Self-Perception Profile in Adults (Messer & Harter, 2012) and identified positive associations with motor competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019) and physical activity (Sackett & Edwards, 2019).

Jiménez-Díaz et al. (2018) employed canonical correlations and discovered that the domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were all positively and significantly associated with motor competence (i.e., TGMD). However, the association between athletic competence and motor competence was stronger (r = 0.990) than between physical appearance and global self-worth and motor competence (r = 0.315; r = 0.209, respectively). When examining locomotor and ball skills, no significant association emerged between the domains of perceived competence and locomotor skills; however, a significant association existed between the domains of perceived competence and ball skills. This result may have implications for the current study's findings. The motor competence variable used in this study included four ball skills (catch process and product, kick and throw process) but only two locomotor skills (jump process and product). The fact that the motor competence variable contained more ball skills than locomotor skills may explain the observed positive yet weak association. Sackett and Edwards (2019) also found significant associations between perceived competence and motor competence. The authors' used correlations to examine associations between domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) to domains of motor competence (i.e., locomotor skills, balls skills, upper-limb coordination, and running speed/agility) (Sackett & Edwards, 2019). Positive and significant associations manifested between athletic competence and all domains of motor competence (Sackett & Edwards, 2019). The authors also uncovered a positive and significant association between the perceived competence domains of physical appearance and global self-worth to the motor competence domains of upper-limb coordination and locomotor skills. Still, no association was found to running speed/agility and ball skills (Sackett & Edwards, 2019). Taken together, these two studies along with the current research demonstrate that athletic competence is significantly associated with motor competence in adults (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). Motor competence was composed of different measurements across the studies, but all came to the same conclusion. However, the present research did not show an association between the perceived competence domains of physical appearance and global self-worth as Jiménez-Díaz et al. (2018) and Sackett and Edwards (2019) did. Notably, the association between physical appearance and global self-worth was not as strong as between athletic competence and motor competence (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). The limitations of the motor competence variable in this study may have contributed to non-significant findings between physical appearance and global worth to motor competence. Also, no association was found between any of the domains of perceived competence and physical activity in parents. These findings do not coincide with those of Sackett and Edwards (2019), who identified all domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were significant correlated with self-reported physical activity. However, upon further analysis, Sackett and Edwards (2019) found that only athletic competence and self-reported physical activity were significantly associated in males. As we had few male adults in this study, this may have contributed to the non-significant findings.

Moreover, this study's finding that perceived competence was not a mediator between motor competence and physical activity in children does not corroborate prior work (Barnett et al., 2008, 2011; Khodaverdi et al., 2015). Barnett et al. (2008) discovered that perceived motor competence mediated children's ball skills and adolescents' self-reported physical activity. Also, upon examining follow-up data with the same sample, perceived competence mediated the association between ball skills and self-reported physical activity (Barnett et al., 2011). Further, Khodaverdi et al. (2015) found that the perceived competence domains of physical ability, physical appearance, peer relationships, and parent relationships mediated the association between motor competence and physical activity.

However, we observed a significant correlation, however in the regression the association between the perceived competence domain of athletic competence and motor competence was approaching significance and no significant findings appeared between perceived competence and physical activity. Studies have shown perceived motor competence to be significantly associated with motor competence (De Meester et al., 2016, 2018, 2020) and physical activity (Babic et al., 2014; De Meester et al., 2016, 2018). De Meester et al.'s (2020) systematic review and meta-analysis revealed a weak but significant association between perceived motor competence and actual motor competence. Further, in two studies assessing the associations between perceived motor competence, actual motor competence, and physical activity, positive associations were observed when using The Self-Perception Profile for Children (Harter, 2012). De Meester et al. (2016) found that higher levels of perceived motor competence and actual motor competence (i.e., TGMD-2) were each associated with more significant physical activity. Upon further analysis, De Meester et al. (2018) also noted that perceived motor competence was associated with both actual motor competence and physical activity; however, the authors did not examine mediation. Babic et al.'s (2014) systematic review showed that perceived competence (i.e., perceived motor competence), perceived fitness, and perceived appearance were significantly related to physical activity. The present study uncovered no associations between the domains of perceived competence (i.e., athletic competence, physical appearance, and global self-worth) and physical activity.

The non-significant associations between perceived competence and physical activity for parents and children may be due to non-significant findings for Research Questions 1 and 2 between motor competence and physical activity in parents and children. It is believed that motor competence and perceived competence each influence physical activity. This study's finding that athletic competence was associated with motor competence, but not physical activity is therefore logical. This outcome also demonstrates that the motor competence variable included in this study assessed motor competence to some degree but was not as robust as the motor competence variables used by Jiménez-Díaz et al. (2018) and Sackett and Edwards (2019) for adults or children (De Meester et al., 2016, 2018).

Research Aim 2

Research Question 1

What is the association between objectively measured physical activity in parent-child dyads?

Hypothesis 1: Parents' physical activity will have a moderately positive association with children's physical activity.

Statistical Analysis

Partial bivariate correlations were adopted to examine the association of physical activity in parent-child dyads, controlling for child gender and parent BMI. Data were then analyzed with OLS multiple linear regressions. Children's physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) served as outcome variables. Parents' matched physical activity (defined as minutes per day spent in MVPA and light, moderate, and vigorous activity) constituted the predictor variable; child gender and parent BMI were added to the models as control variables (Jago et al., 2014).

Results

Descriptive statistics. A total of 48 parent-child dyads were included in partial bivariate correlations and OLS multiple linear regressions. The mean of parents' MVPA was 51.38 ± 23.17 minutes per day, that of light activity was 84.34 ± 25.97 minutes per day, that of moderate activity was 45.79 ± 20.63 minutes per day, and that of vigorous activity was 5.60 ± 4.35 minutes per day. The mean of children's MVPA was 47.47 ± 18.62 minutes per day, that of light activity was 100.99 ± 31.06 minutes per day, that of moderate activity was 25.33 ± 8.86 minutes per day, and that of vigorous activity was 22.15 ± 11.67 minutes per day.

Physical activity. A partial bivariate correlation was calculated between parents' and children's physical activity while controlling for child gender and parent BMI. Our hypothesis was supported given a moderate significant correlation between parents' and children's MVPA [$r(48) = 0.39$, $p = 0.008$]. We also found a weak significant correlation between parents' and children's moderate physical activity [$r(48) = 0.34$, $p = 0.020$]. No significant association appeared between parents' and children's light or vigorous physical activity ($r = -0.01$ and $r = 0.06$, respectively).

Then, OLS multiple linear regressions were calculated to predict children's physical activity (MVPA, light, moderate, and vigorous) matched to parents' physical activity (MVPA, light, moderate, and vigorous), controlling for child gender and parent BMI. For the MVPA model, when controlling for child gender and parent BMI, parents' and children's MVPA were significantly associated ($\beta = 0.30 \pm 0.11$; $p = 0.008$): a one-unit increase in parents' MVPA was associated with a 0.30-unit increase in children's MVPA. In the moderate physical activity model, when controlling for child gender and parent BMI, parents' moderate physical activity was significantly associated with that of children ($\beta = 0.15 \pm 0.06$; $p = 0.020$); that is, a one-unit increase in parents' moderate physical activity was associated with a 0.15-unit increase in children's moderate physical activity. For the light and vigorous physical activity models, after controlling for BMI and gender, the associations between children's and parents' light and vigorous physical activity were non-significant (ps > 0.05; see Table IV.18).

Table IV.18. Predictors of change for children's physical activity.

		Baseline					C Gender					C Gender & P BMI				
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
C MVPA	Intercept	29.6	6.01	<0.001	0.19		28.33	6.47	0.001	0.19	0.01	53.57	16.0	0.002	0.24	0.05
	P MVPA	0.35	0.11	**0.002***			0.35	0.11	**0.002***			0.303	0.11	**0.008***		
	C Gender						3.00	5.18	0.565			1.50	5.14	0.772		
	P BMI											-0.82	0.48	0.093		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
C Light	Intercept	95.9	15.5	<0.001	0.00		93.41	15.9	<0.001	0.02	0.01	139.9	31.5	<0.001	0.08	0.06
	P Light	0.06	0.18	0.733			0.06	0.18	0.740			-0.01	0.18	0.970		
	C Gender						7.32	9.51	0.445			4.97	9.41	0.600		
	P BMI											-1.49	0.87	0.096		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
C Moderate	Intercept	17.8	2.93	<0.001	0.15		16.77	3.16	<0.001	0.16	0.01	26.55	7.97	0.002	0.20	0.03
	P Mod	0.17	0.06	**0.007***			0.170	0.06	**0.006***			0.15	0.06	**0.020***		
	C Gender						2.15	2.51	0.396			1.55	0.23	0.544		
	P BMI											-0.32	0.24	0.189		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
C Vigor	Intercept	21.1	2.79	<0.001	0.01		21.04	3.05	<0.001	.01	0.00	40.10	9.29	<0.001	0.10	0.10
	P Vigor	0.19	0.40	0.635			0.19	0.40	0.641			0.15	0.39	0.699		
	C Gender						0.16	3.60	0.964			-0.92	3.49	0.794		
	P BMI											-0.68	0.32	0.036		

Note. MVPA = moderate to vigorous physical activity; Vigor = vigorous; P = parent; C = child; BMI = body mass index; $^*p < 0.05$.

Research Question 2

What is the association between motor competence in parent-child dyads?

Hypothesis 2: Parents' motor competence will have a moderately positive association with children's motor competence.

Statistical Analysis

Partial bivariate correlations were carried out to evaluate the association of motor competence in parent-child dyads, controlling for child gender and parent BMI. Data were then analyzed using OLS multiple linear regressions. Children's motor competence served as the outcome variable, parents' motor competence was the predictor variable, and child gender and parent BMI were added to the model as control variables. Additional models were computed with children's process and product motor skills serving as outcome variables, matched parents' process and product motor skills as the predictor variable, and child gender and parent BMI added to the models as control variables.

Results

Descriptive statistics. Forty-three parent-child dyads were included in bivariate correlations and OLS multiple linear regression. The mean of parents' motor competence was 0.20, SD ± 1.88, that of process motor skills was 0.00 ± 1.00 (as this was the original z-score), and that of product motor skills was 0.08 ± 1.35. The mean of children's motor competence was 0.31 ± 2.08, that of process motor skills was 0.07 ± 0.96, and that of product motor skills was 0.10 ± 1.46.

Motor competence. Partial bivariate correlations were calculated between parents' and children's motor competence, process skills, and product skills. There was a moderate significant correlation between parents' and children's motor competence [$r(43) = 0.39$, $p = 0.012$]. A weak significant association was found between parents' and children's process skills [$r(43) = 0.39$, $p = 0.009$] and between parents' and children's product skills [$r(43) = 0.36$, $p = 0.021$].

Next, OLS multiple linear regressions were calculated to predict children's motor competence based on parents' motor competence, controlling for child gender and parent BMI. In this case, parents' motor competence was significantly associated with children's ($\beta = 0.46 \pm 0.18$; $p = 0.012$), with a one-unit increase in parents' motor competence associated with a 0.46-unit increase in children's motor competence. Two additional models were calculated to predict children's process motor skills and product motor skills based on parents' process and product motor skills while controlling for child gender and parent BMI. In the process skills model, when controlling for child gender and parent BMI, parents' process skills were significantly associated with those of children ($\beta = 0.40 \pm 0.15$; $p = 0.009$): a one-unit increase in parents' process motor skills was associated with a 0.40-unit increase in children's process motor skills. Also, when controlling for parents' process scores and BMI, gender predicted children's process motor skills ($\beta = 0.58 \pm 0.26$, $p = 0.03$); more specifically, boys had stronger process motor skills than girls. In the product skills model, upon controlling for child gender and parent BMI, parents' product skills were significantly associated with children's product skills ($\beta = 0.42 \pm 0.17$; $p = 0.021$): a one-unit increase in parents' product skills led to a 0.42-unit increase in children's product skills. Table IV.19 presents a summary of these findings.

Table IV.19. Predictors of change for children's motor competence.

		Baseline					C Gender					C Gender & P BMI				
		b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²
C MC	Intercept	0.23	0.31	0.451	0.11		-0.20	0.39	0.62	0.17	0.06	-1.78	1.59	0.269	0.19	0.02
	P MC	0.37	0.16	**0.028***			0.39	0.16	**0.020***			0.46	0.18	**0.012***		
	C Gender						1.02	0.60	0.097			1.06	0.60	0.086		
	P BMI											0.60	0.06	0.310		
		b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²
C Process	Intercept	0.07	0.13	0.595	0.15		-0.15	0.16	0.359	0.23	0.08	-0.77	0.59	0.197	0.25	0.02
	P Process	0.37	0.13	**0.008***			0.32	0.13	**0.016***			0.40	0.15	**0.009***		
	C Gender						0.568	0.26	**0.037***			0.58	0.26	**0.033***		
	P BMI											0.02	0.02	0.280		
		b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²	b	SE	*p*	R²	Δ R²
C Product	Intercept	0.07	0.21	0.728	0.12		-0.14	0.28	0.633	0.15	0.03	-0.25	1.11	0.82	0.15	0.00
	P Product	0.38	0.16	**0.019***			0.41	0.16	**0.031***			0.42	0.17	**0.021***		
	C Gender						0.48	0.43	0.271			0.48	0.43	0.275		
	P BMI											0.00	0.04	0.914		

Note. MC = motor competence; P = parent; C = child; BMI = body mass index; *$p < 0.05$.

Research Question 3

What is the association between perceived competence in parent-child dyads?

Hypothesis 3: Parents' perceived competence will have a moderately positive association with children's perceived competence.

Statistical Analysis

Bivariate correlations and OLS linear regressions were computed. The three domains of children's perceived competence (i.e., athletic competence, physical appearance, and global self-worth) were outcome variables. The three matched domains of parents' perceived competence (i.e., athletic competence, physical appearance, and global self-worth) served as predictor variables.

Results

Descriptive statistics. A total of 49 parent-child dyads were included in the bivariate correlations and OLS linear regressions. The mean of parents' athletic competence was 2.36 ± 0.84, that of physical appearance was 2.60 ± 0.71, and that of global self-worth was 3.13 ± 0.47. The mean of children's athletic competence was 2.83 ± 0.76, that of physical appearance was 3.10 ± 0.68, and that of global self-worth was 3.13 ± 0.50.

Perceived motor competence. A bivariate correlation was calculated between parents' perceived competence (i.e., athletic competence, physical appearance, and global self-worth) and matched children's perceived competence (i.e., athletic competence, physical appearance, and global self-worth). No significant association was found between parents' and children's athletic competence (r = 0.08), physical appearance (r = 0.19), or global self-worth (r = 0.05).

A bivariate OLS linear regression was calculated to predict children's perceived competence on parents' perceived competence. The associations between all three domains of children's perceived competence and matched domains of parents' perceived competence were non-significant (see Table IV.20).

Table IV.20. Predictors of change for children's perceived competence.

		b	SE	*p*	R^2
C AC	Intercept	2.665	0.331	<0.001	0.006
	P AC	0.068	0.132	0.608	
C PA	Intercept	2.633	0.367	0.000	0.034
	P PA	0.176	0.136	0.203	
C SW	Intercept	2.976	0.436	<0.001	0.003
	P SW	0.049	0.138	0.722	

Note. AC = athletic competence; PA = physical appearance; SW = global self-worth; P = parent; C = child.

Discussion

This study showed that parents' MVPA and moderate physical activity were significantly correlated with children's MVPA and moderate physical activity. The associations remained significant in OLS multiple linear regressions when controlling for child gender and parent BMI. These moderate associations reflect prior research assessing parents' and children's physical activity using objective measurements (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011).

The correlation found in this study (r = .39) between parents' and children's MVPA was comparable to that identified by Fuemmeler et al. (2011); they noted a weak to moderate significant association between fathers' (r = .37) and mothers' (r = .42) MVPA to their children's MVPA. Fuemmeler et al. (2011) used accelerometers to measure parents' (45 mothers and fathers) and their children's physical activity (mean age: 9.9 years). Our findings are similar and can be attributed to these studies' similar sample sizes, similar age ranges, and focus on MVPA. As a major difference, we only examined one parent's physical activity.

Comparisons to the other studies that objectively measured parents' and children's physical activity are more challenging given differences in samples' age ranges and the overall methodology. However, all three studies revealed a positive and significant association between parents' and children's physical activity (Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Jago et al. (2014) found a weak association between parents' and preschool-aged children's physical activity, concluding that parents' and children's physical activity may not be as important as believed. Ruiz et al. (2011) identified a strong association between total, light, and moderate physical activity (r = 0.61, r = 0.90, and r = 0.74), respectively, whereas Moore et al. (1991) uncovered a moderate association between parents' and children's physical activity (r = 0.46). No association was observed between light or vigorous physical activity in the present study. Ruiz et al. (2011) did not find an association between parents' and children's vigorous physical activity and attributed this outcome to parents having only a few minutes of vigorous physical activity, as seen in the current study: parents completed a mean of 5.60 minutes of vigorous physical activity per day on average compared to children's 22.15 minutes per day. However, we observed no association between light physical activity between parents and children; this result may signify that the association between parents' and children's MVPA is the most powerful parent determinant of children's physical activity.

The finding that parents' and children's MVPA and/or moderate physical activity are significantly associated has important implications based on the Physical Activity Guidelines for Americans. Children ages 6–17 should engage in 60 minutes of MVPA each day, while adults should engage in at least 150–300 minutes of moderate intensity or 75 minutes of vigorous intensity physical activity each week (US Department of Health and Human Services, 2018). MVPA has health-enhancing benefits for children and parents (US Department of Health and Human Services, 2018). The association between parents' MVPA and moderate physical activity and children's MVPA and moderate physical activity can guide interventions to support parents and children in meeting physical activity recommendations.

To our knowledge, this study is the first to evaluate the association between parents' and children's motor competence. We found support for our hypothesis that parents' and children's motor competence were significantly correlated. Further analyses revealed that both process and product motor skills were weak but significantly correlated as well. This association remained significant following OLS multiple linear regressions controlling for child gender and parent BMI. In the process skill model, gender also predicted motor competence, as boys exhibited stronger process skills than girls. This pattern coincides with research demonstrating that boys outperform girls in motor competence among preschool populations (Goodway et al., 2010; Spessato et al., 2012; Vameghi et al., 2013; Yang et al., 2015), elementary-aged children (Hardy et al., 2012), and high school-aged youth (Barnett et al., 2010). However, we found that gender did not predict overall motor competence or product skills, similar to Palmer et al. (2020).

In examining parents' and children's motor competence, this study's results support recent work by Jarvis et al. (2020) regarding parent determinants of children's (aged 9–11 years) motor competence. Specifically, Jarvis et al. (2020) discovered that the family environment, parent behaviors, and parent beliefs each influenced children's motor competence. Even so, only children's motor competence was assessed objectively; parents completed a questionnaire. Prior research in motor development examined general determinants of children's motor competence and highlighted parents as playing significant roles (Barnett et al., 2016b; Iivonen & Sääkslahti, 2014; Niemistö et al., 2019). Overall, our study provides evidence of parents' motor competence as a key factor influencing their children's motor competence.

Findings from this study also indicated that parents' and children's physical and motor competence were positively and significantly associated. These outcomes align with the two conceptual models explaining parent determinants of children's physical activity (Davison et al., 2013; Mâsse et al., 2017). In Davison et al.'s (2013) model, parents' physical activity attributes (e.g., parents' physical activity) are associated with children's physical activity, including minutes of MVPA. In the model by Mâsse et al. (2017), the structure of physical activity (e.g., co-participation and modeling) influences children's physical activity. The present study only examined parents' and children's behavior; thus, we could not discern parents' roles in influencing these behaviors (e.g., co-participation, modeling). We expected to find a positive and significant association between physical activity and motor competence. Parents are the most influential people in children's lives due to having the most contact hours with and control over their child's activities (Yao & Rhodes, 2015). Also, parents' physical activity levels are a significant and critical factor in children's physical activity (Garriguet et al., 2017; Hutchens & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015). We, therefore, posited that a similar association would exist for motor competence. Our results highlight the importance of parents' physical activity and motor competence, which appear positively and significantly associated with those of their children.

We further presumed that parents' and children's perceived competence would be significantly associated. This hypothesis was based on the significant association between parents' and children's physical activity (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). However, we did not observe a significant association between parents' and children's perceived competence in any of the three domains (athletic competence, physical appearance, and global self-worth). Under Aim 1, we identified a signficant association between the athletic competence domain of perceived competence to motor competence in parents. This association was approaching signficance among children. We were surprised not to find a significant association between parents' and children's athletic competence. Non-significant findings can be attributed to limitations of the Self-Perception Profile for Adults and Children.

Parents' and children's means for athletic competence, physical appearance, and global self-worth were all similar.

Research Aim 3

Research Question 1

What is the association between parents' motor competence and children's physical activity?

Hypothesis 1: Parents' motor competence levels will have a moderately positive association with children's physical activity.

Statistical Analysis

Partial bivariate correlations were conducted to examine the association of parents' motor competence and children's physical activity. Data were analyzed using OLS multiple linear regressions. Children's physical activity (defined as MVPA and light, moderate, and vigorous minutes per day) served as the outcome variable, parents' motor competence was the predictor variable, and child gender and parent BMI were added to the models as control variables.

Results

Descriptive statistics. Forty parent-child dyads were included in bivariate correlations and OLS multiple linear regression. The mean of parents' motor competence was 0.39 ± 1.76. The mean of children's MVPA was 48.67 ± 17.36 minutes per day, that of light activity was 103.53 ± 29.94 minutes per day, that of moderate activity was 26.36 ± 8.35 minutes per day, and that of vigorous activity was 22.32 ± 11.13 minutes per day.

Children's physical activity. A partial bivariate correlation was calculated between parents' motor competence and children's physical activity (MVPA and light, moderate, and vigorous activity). There were no significant associations between parents' motor competence and children's MVPA (*r* = 0.07), light (*r* = .02), moderate (*r* = 0.02), or vigorous (*r* = .09) physical activity.

Next, OLS multiple linear regressions were calculated to predict children's physical activity (MVPA, light, moderate, and vigorous) in minutes per day based on parents' motor competence while controlling for child gender and parent BMI. The associations between parents' motor competence and children's MVPA and light, moderate, and vigorous activity (average minutes per day) were non-significant (*p*s > 0.05; see Table IV.21).

Discussion

This research question was more exploratory, as we hypothesized that parents' motor competence would have a moderate positive association with children's physical activity. This postulation was based on conceptual models in motor development created by Stodden et al. (2008), Robinson et al. (2015a), and Hulteen et al. (2018); all have shown a positive and significant association between motor competence, physical activity, and the conceptual models explaining parent determinants of children's physical activity (Davison et al., 2013; Mâsse et al., 2017). This hypothesis was not supported: we found no significant associations between parents' motor competence and children's physical activity.

In Aim 1, we did not observe any significant associations between motor competence and physical activity in parents or children. These findings were attributed to this study's online format, specifically problems with the online motor competence assessement and the motor competence variable. Due to these limitations, it was unsurprising to see no association between parents' motor competence and children's physical activity.

However, motor competence and physical activity are associated (Robinson et al., 2015a; Stodden et al, 2008), and parents play significant roles in their children's health behaviors via parents' behavioral attributes (Davison et al., 2013) and structure (Mâsse et al., 2017). Davison et al. (2013) pinpointed attributes including one's history of physical activity, current physical activity, physical activity enjoyment, value, and self-efficacy as promoting physical activity (Davison et al., 2013). Mâsse et al. (2017) defined structure as encompassing co-participation, expectations, facilitation, modeling, monitoring, and restriction for safety. Based on these conceptual models, one can speculate that parents' motor competence might be associated with their children's physical activity. No study has assessed the association between parents' motor competence and children's physical activity to the author's knowledge. Our work revealed that parents' physical activity and motor competence were associated with their children's physical activity and motor competence, echoing earlier research (Fuemmeler et al., 2011; Jago et al., 2014; Jarvis et al., 2020; Moore et al., 1991; Ruiz et al., 2011). Thus, we may not have accurately evaluated the association between parents' motor competence and children's physical activity. Future research should further examine this association in a controlled environment using validated motor competence assessments. Such a study would be similar to the original dissertation study proposal and would provide greater insight into the association of physical activity and motor competence in parent-child dyads.

Table IV.21. Predictors of change for children's physical activity.

		Baseline					C Gender					C Gender & P BMI				
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
MVPA	Intercept	48.1	2.82	<0.001	0.02		48.39	3.55	<0.001	0.02	0.00	69.11	15.5	<0.000	0.07	0.05
	P MC	1.48	1.6	0.356			1.49	1.61	0.359			0.69	1.69	0.684		
	C Gender						-0.81	5.77	0.890			-1.79	5.75	0.757		
	P BMI											-0.76	0.56	0.179		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Light	Intercept	103	4.90	<0.001	0.01		103.6	6.18	<0.001	0.01	0.01	131.9	27.2	<0.001	0.04	0.03
	P MC	1.46	2.75	0.598			1.50	2.79	0.898			0.40	2.97	0.893		
	C Gender						-1.60	10.0	0.299			-2.95	10.1	0.772		
	P BMI											-1.04	0.98	0.292		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Moderate	Intercept	26.2	1.37	<0.001	0.01		26.34	1.72	<0.001	0.01	0.00	33.8	7.62	<0.001	0.03	0.03
	P MC	0.37	0.77	0.635			0.38	0.78	0.633			0.09	0.83	0.918		
	C Gender						-0.36	2.80	0.900			-0.71	2.82	0.803		
	P BMI											-0.28	0.27	0.320		
		b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2	b	SE	*p*	R^2	ΔR^2
Vigorous	Intercept	21.9	1.80	<0.001	0.03		22.05	2.27	<0.001	0.03	0.00	35.29	9.90	0.001	0.08	0.05
	P MC	1.11	1.01	0.279			1.12	1.03	0.283			0.608	1.08	0.577		
	C Gender						-0.45	3.68	0.903			-1.08	3.67	0.770		
	P BMI											-0.49	0.36	0.178		

Note. MVPA= moderate to vigorous physical activity; MC = motor competence; P = parent; C = child; BMI = body mass index.

Research Aim 4

Research Question 1

What are parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor skills?

> **1a:** What motivates parents and children to engage in physical activity and develop motor competence?
>
> **1b:** What are parents' perceived roles in encouraging physical activity?

Research Question 2

What do parents and children identify as the benefits and barriers of physical activity?

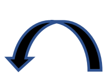
Research Question 3

How has COVID-19 affected parents' and children's physical activity and motor competence?

Data Analysis

Data were analyzed sequentially as follows:

1. Reviewed data throughout the data collection process.
2. Read and re-read all data as a whole per Maxwell's (2013) recommendation.
3. The author and a research assistant in the School of Kinesiology, Movement Science who had worked in the Child Movement, Activity, and Developmental Health Laboratory for three years engaged in independent coding informed by grounded theory. We first engaged in line-by-line coding and next employed the constant comparative method to develop initial and focused codes that were then categorized into analytic themes (these steps are iterative):



   - Engaged in initial coding via line-by-line coding
   - Developed initial codes

- Developed focused codes
- Developed analytic themes

4. Discrepancies between the two researchers' focused codes and themes were discussed and resolved.
5. Identified 29 focused codes that were classified into 7 analytic themes to draw conclusions and enhance understanding.
6. Triangulated interviews and home environment assessments, questionnaires, and assessments of motor competence and physical activity to verify data validity.
7. Prepared a summary and descriptions of findings.

Results

Participant characteristics. Twelve parent-child dyads participated in semi-structured interviews. The families' pseudonyms are Smith, Jones, Miller, Williams, Johnson, Brown, Davis, Thomas, Lee, Martin, Anderson, and Taylor; see Table IV.10 and Table IV.11 for dyad profiles.

Beliefs. Seven overarching themes emerged from the data: knowledge, perceptions, engagement, benefits, barriers, motivators, and COVID-19. Table IV.22 presents the progression and development of initial codes, focused codes, and themes. Table IV.23 lists definitions and examples for each theme.

Table IV.22. Development of initial codes, focused codes, and themes.

Initial Codes	Focused Codes	Themes
Parent definition PA Parent definition exercise Parent examples PA Parent definition MS Parent development MS Parent examples MS Child definition PA Child definition exercise Child examples PA Child definition MS	Parent knowledge PA Parent knowledge MS Child knowledge PA Child knowledge MS	Knowledge
Parent positive perception PA Parent negative perceptions PA	Parent general perceptions Parent perceptions of self	Perceptions

Parent positive perception MS Parent negative perception MS Parent positive perception own PA Parent negative perception own PA Parent positive perception own MS Parent negative perception own MS Parent perception of child Parent perception of other children Parent perception of partner Child positive perception PA Child negative perception PA Child perception MS Child positive perception own PA Child negative perception own PA Child positive perception own MS Child positive perception own MS Child perceptions of siblings PA Child perceptions of siblings MS Child perceptions of parents PA Child perceptions of parents MS	Parent perceptions of others Child general perceptions Child perceptions of self Child perceptions of others	
Parent gym membership Parent favorite PA activities Parent how often participation Parent activities would like to try Child sports participation Child favorite PA activities Child how often participation Child activities would like to try Family activities PA Family activities how often Exercise equipment Sports equipment Outside space around the home Inside space around the home Parks proximity	Parent engagement Child engagement Family engagement Space and equipment	Engagement
Health physical benefits Health mental benefits Benefits friends Parents benefits for their children Away from technology Family time together Parent importance PA & MS Child importance PA & MS	Parent benefits Child benefits Family benefits	Benefits
Motivation Interest Weather Time Technology Lack of resources Lack of access No one to play with COVID-19	Parent barriers Child barriers Family barriers	Barriers

Friends motivator Siblings motivator Scheduled practices Fun/ enjoyment Accountability Parent role	Parent motivators Child motivators Family motivators Parent role model	Motivators
Parent COVID-19 work status Parent COVID-19 activity level Parent COVID-19 barriers Child COVID-19 school status Child COVID-19 day experiences Child COVID-19 PE experiences Child COVID-19 activity level Child COVID-19 barriers	Parent work status Child school status Child PE class COVID-19 activity level COVID-19 barriers	COVID-19

Note. PA = physical activity; MS = motor skills; PE = physical education.

Table IV.23. Definition and examples by theme.

Theme	Definition	Examples
Knowledge	Definitions and examples of physical activity and motor skills.	Williams Parent: *Physical activity means moving your body in a way that will elevate your heart rate beyond its resting point – for example, running, playing soccer, riding a scooter, jumping on a trampoline.* Taylor Child: *Physical activity, exercise, or whatever you want to call it.*
Perceptions	Viewpoints about physical activity and motor skills, including in general, for oneself, and for others.	Anderson Parent: *Okay, I'm fine with physical activity, I really love to dance. So that's where I get my physical activity, or walking.* Smith Child: *Sometimes it's fun to do. But then sometimes I don't really feel like doing it.*
Engagement	The types of physical activity and motor skills activities in which parents and children participate.	Johnson Parent: *Are you familiar with the Beachbody on Demand? I do that. So, you know, usually weightlifting and cardio.* Williams Child: *Riding my bike, jumping on the trampoline, and playing games like basketball or soccer.*
Benefits	Identified the positives and importance that make participating in physical activity and motor skills worthwhile.	Brown Parent: *General health, cardiac health, sleep, helps with general conditioning, mental acuity, and mood.* Brown Child: *Because it helps your muscles grow.*
Barriers	Identified challenges that make participating in physical activity and motor skills difficult.	Thomas Parent: *Sometimes it is attitude…sometimes it's the weather.* Davis Child: *So, we're really busy, which kind of takes away a lot of time for us to get active together.*
Motivators	Either something or someone that promotes interest and	Lee Parent: *I think fun is the big thing. If we can find ways to make it more fun or even add a challenge to physical activity.*

	enthusiasm to participate in physical activity.	Johnson Child: *Well, one thing I find that makes me active more is when they tell me to be active on my chore list.*
COVID-19	Factors affecting physical activity and motor competence due to COVID-19 (e.g., school/work status, positives, and negatives).	Jones Parent: *When I was working in the office, we have group exercise classes. We could get out and go for walks on our breaks. I mean, I sort of do that now, but not as religiously as I did before [COVID-19].* Miller Child: *Well during the summer I was a bit more active because we went to Cedar Point [amusement park] more, but since it closed in November, I have been definitely a lot less active because there weren't any excuses for me to go out.*

Knowledge. Knowledge was defined as definitions and examples of physical activity and motor skills. The "knowledge" theme consisted of focused codes about knowledge of physical activity and motor skills among parents and children. Most parents accurately defined physical activity as any bodily movement. Three parents (Johnson, Brown, and Davis) further discussed their perceptions of physical activity as a combination of movement and exercise. Johnson parent said:

> Yeah, you know, I think there's really kind of two components to physical activity. One is like the general movement you do throughout the day. Like, some people just move more than other people move, and then there is also an exercise component. Whether you, like, actually work out and, you know, have a strict training plan or do cardio to raise your heart rate or whatever.

One parent (Martin) defined physical activity more in terms of exercise but alluded to the idea of physical activity being an important movement: "To me [physical activity] means exercise. It also means sports. It means staying healthy, it means keeping everything…Yeah, mostly staying healthy, moving, running, sports." Parents provided examples of physical activity that incorporated movement ranging from daily tasks (e.g., cleaning, not sitting at a desk all day) to more intentional activities (e.g., taking a walk, playing sports). All parents accurately defined motor skills broadly as a combination of coordination and the ability to use one's body to complete tasks. Parents also addressed fine and gross motor skills. As Miller parent said, "Motor skills are the muscle coordination you have in your body, whether it's fine motor skills like fingertip touching or large motor skills of using your arms and legs." Parents gave examples of various motor skills used in daily activities and sports, such as running, jumping, throwing, and catching. Regarding motor skill development, most parents mentioned the need to practice and reinforce motor skills. Two parents (Brown and Martin) believed that motor skills mostly come naturally, and people only need to practice them to get better. As Brown parent said:

> Having watched babies grow, I would say a fair number of [motor skills] come naturally. But also, my own experience tells me that they can be developed so that they can be effective versus you might have the physical ability to stand, but balance can be improved.

All but two children defined physical activity as being in line with exercise; Smith child said "Working out," and Jones child said "Like you work out and you do a ton of exercises." Only Williams and Anderson children described physical activity in terms of movement. Williams child said, "Being active and doing, like, active stuff. Running, kicking, riding your bike," whereas Anderson child said "To move around." Children's examples of physical activity included sport activities such as baseball, football, skiing, and riding bikes. Only two children, Johnson and Smith, were able to define motor skills. Anderson child said, "It's pretty much like your ability to move. It is hard to explain." Smith child said, "Like, the body or, like, what your body does when you work out." The other children either did not know what motor skills were or incorrectly defined them as an unrelated topic (e.g., exercise bike; related to NASCAR).

Perceptions. Perceptions were defined as overall viewpoints (i.e., general outlook/importance, personal, and others) about physical activity and motor skills. This theme consisted of several focused codes: parents' general perceptions, parents' perceptions of self, parents' perceptions of others, child's general perceptions, child's perceptions of self, and child's perceptions of others.

Every parent perceived physical activity and motor skills as important. Most parents mentioned that these skills influence mental and physical health. Taylor parent stated:

> I think it's very important because it promoted, like, a whole sense of wellness for your life and ability to take part in many different activities both as a kid and as an adult. And I think mentally it's important for me to be physically active for my mental-well-being.

Davis parent said, "Yeah, I think both of those [physical activity and motor skills] are important for the physical well-being and just kind of your overall emotional and complete, like, total well-being." One parent, Martin, noted that physical activity is beneficial for one's mental and physical health and should be a way of life:

> I want the kids to learn and see that this [physical activity] is a way of life. It is not something you just do as a kid, you do it your entire life. It's fun and it's how we take care of our bodies and minds. It doesn't have to be sports, it can look many different ways and for us it is hiking, biking, skiing, and traveling/exploring. Trying new things together. I'm hopeful they do this with their kids and families.

Each parent had a positive perception of physical activity as something they liked, enjoyed, or loved. However, most parents discussed barriers that prevented them from being as physically active as they would like. Davis parent stated, "I enjoy it once I get out and actually start it." Miller parent said, "I like doing physical activity, but I do need that outside force to make me do it." Many parents recognized the benefits of participating in regular physical activity. One parent, Johnson, pointed out that they enjoyed physical activity rather than exercise: "I think it's really important to be physically active. I do enjoy being physically active throughout the course of the normal things I do. I don't specifically enjoy exercising, although I am pretty religious about exercising." This parent thus enjoyed physical activity but distinguished it from exercise, which they perceived negatively. Seven parents (Anderson, Davis, Thomas, Brown, Lee, Williams, and Jones) explained that they were not as physically active as they would like, while the other five parents (Smith, Miller, Johnson, Martin, and Taylor) believed themselves to be fairly active.

Regarding parents' perceptions of children's physical activity and motor competence, two parents (Smith and Anderson) mentioned that they did not think their children were especially physically active. Most other parents perceived their children as being fairly active and skilled. Parents also said that, even though they found their children to be fairly active, children would sometimes need encouragement to do so. For example, Thomas parent stated, "I think [my son] is very active, sometimes he just needs a little support and push to get outside."

Children shared similar perceptions; they believed that physical activity was important. Once motor skills had been defined and discussed, children recognized these skills as useful as well. Children mentioned that physical activity helped expend energy, feeling good, and staying healthy. As Miller child said, "It's how you keep your body healthy." Children also perceived physical activity positively as long as they engaged in activities that they enjoyed and were not overextended. Smith child said, "Sometimes it's fun to do. But then sometimes I don't really feel like doing it." Taylor child said, "I enjoy it when I am doing things I like" and Miller child said, "It depends what kind of physical activity." All children enjoyed physical activity when the activity interested them.

Additionally, children perceived themselves as fairly active and skilled. Only two children (Smith and Anderson) admitted they were not fairly active. Other children considered themselves active but admitted they could accumulate more physical activity on some days.

Engagement. The physical activity and motor skills activities in which parents and children participated were collectively labeled "engagement." Focused codes consisted of parent engagement, child engagement, family engagement, and space and equipment. According to home environment assessments and interviews, all parent-child dyads had equipment at home that supported physical activity and motor skills (see Table IV.24). The home environment assessment and interviews were complementary: parent-child dyads discussed engagement and, more specifically, equipment and accessibility. Ten parent-child dyads lived in a single-family home, one parent-child dyad lived in a townhome, and one parent-child dyad lived in an apartment. Many parent-child dyads discussed living near parks and having open spaces either in their yard or close by to use. The only family with limited access to space was the Anderson family, who lived in an apartment on a busy road. In terms of other equipment mentioned throughout interviews, three families owned trampolines and four families owned treadmills.

Regarding parent engagement, all parents discussed regularly participating in some type of physical activity. Parents' preferred activities included walking, running, cardio drumming, Zumba/dance workout classes, and online fitness challenges/classes. Parents who perceived themselves as active (Johnson, Taylor, Smith, Miller, and Martin) reported working out between three and six days per week.

Each child also discussed their favorite activities. Seven children mentioned participating in organized sports. Davis child was on a baseball team, Martin and Johnson children were on baseball and basketball teams, Thomas and Lee children were on football teams, Brown child was on a soccer team, and Taylor child participated in horseback riding and basketball. These seven children also noted COVID-19-related sports constraints, such as canceled or shorter seasons, fewer practices, and so on. Other favorite physical activities among children included taking walks; running around the house; riding bikes; swimming; jumping on the trampoline; wrestling with siblings; and skiing, sledding, and ice skating in the winter. The two children who perceived themselves as not active (Smith and Anderson) explained that they did not engage in much physical activity due to a lack of motivation and online schooling. In a conversation about engaging in physical activity, Smith child said, “Um, I guess, just like I don’t really like it because I would rather, like, do other things and it’s just, like, I don’t really see, like, a point to it.”

For family engagement, all parent-child dyads discussed the positives of being physically active as a family. Families participated in numerous activities. The Anderson, Jones, Brown, Johnson, and Lee families discussed regularly taking walks and/or hikes as a family. The Thomas and Jones families enjoyed bike rides. The Smith and Martin families discussed running races as a family. The Martin and Brown families enjoyed skiing, and the Brown and Davis families enjoyed playing and passing the frisbee. Each family mentioned at least one physical activity that they enjoyed together.

Table IV.24. Home environment assessment findings in relation to engagement.

Family	**Type of Home**	**In-Home Space**	**Out-of-Home Space**	**Condition of Outside Space**	**Bike**	**Skateboard or Scooter**	**Exercise Equipment**	**Movement Games**	**Sports balls or Equipment**	**Playground**
Smith	Townhome	Agree	Strongly Agree	Good Condition	Yes	No	Yes	Yes	Yes	No
Jones	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	Yes
Miller	Single-Family	Agree	Strongly Agree	Good Condition	Yes	Yes	Yes	Yes	Yes	No
Williams	Single-Family	Agree	Strongly Agree	Fair Condition	Yes	Yes	Yes	Yes	Yes	No
Johnson	Single-Family	Strongly Agree	Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	Yes
Brown	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	No
Davis	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	No
Thomas	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	No
Lee	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	No
Martin	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	Yes	Yes	Yes	Yes	No
Anderson	Apartment	Agree	Strongly Disagree	Poor Condition	No	No	Yes	No	Yes	No
Taylor	Single-Family	Strongly Agree	Strongly Agree	Excellent Condition	Yes	No	Yes	Yes	Yes	No

Benefits. Benefits were defined as the identified factors that make participating in physical activity and motor skills worthwhile. Focused codes under this theme were parent benefits, child benefits, and family benefits. Discussions of benefits overlapped with the category of perceived importance. Parents' most frequently identified benefits were mental and physical health. Anderson parent stated an added benefit of being able to stay away from doctors. Martin parent discussed how physical activity leads to other positive health outcomes, such as better eating habits and nutrition. Miller and Thomas parents each highlighted the importance of continuing to be active as one ages; Miller parent said, "You use it or you lose it, especially over 40."

Parents also discussed more general benefits for themselves and their families. Martin parent cited one benefit of family physical activity as being able to try new things together:

> The benefit [is] being together, but also the sport of it. Once you get [kids] out there, they love it. Even like throwing a baseball with me. I can't throw very far, but they're still like, 'Come on, get your glove, let's throw.' It works really well when they teach me right. So yeah, just hanging out together, being together.

Lee parent discussed the benefit of the family being together, going outside, and unplugging from electronics and screens. Martin parent described the benefits of their children participating in sports as a "chance to gain friendship, responsibility, accountability, learn how to win and lose, and discipline."

Child-identified benefits revolved around health (e.g., weight control and staying in shape), expending energy, feeling good, and playing with friends. Each child discussed physical activity in terms of being healthy. Taylor child said, "To stay healthy. To live longer." Two children (Johnson and Anderson) focused on benefits related to weight. Lee child stressed the benefit of staying in shape; they said that, when they stopped being physically active for a while and then started again, they felt sore and had difficulty breathing. Jones child stated another benefit as "Just feel[ing] good." Many children also mentioned the benefits of playing and hanging out with their family and friends, although all children mentioned not playing with friends as much since COVID-19. Williams child said "I like doing it with my friends" and then added, "I just like doing it as a family and being active – those are two of my favorite things." Most of the benefits that children discussed were related to the importance of physical activity and engaging in such activity with siblings and friends.

Barriers. Barriers were defined as obstacles that made participating in physical activity and motor skills challenging. Focused codes covered parent, family, and child barriers. Parents' self-identified barriers included time, health issues, weather, cost, and motivation. Nearly every parent stated that a lack of time contributed to their lack of physical activity, such as having a busy schedule and shuttling children to and from events. However, some parents acknowledged having more time since COVID-19, especially with children's activities being at least partially halted. Health issues related to getting older and no longer participating in activities they enjoyed represented additional barriers. Many parents also mentioned the weather; Thomas parent said, "It's just so cold outside." Miller parent noted that the cost for participating in physical activity (e.g., a gym membership) could be expensive. This parent said they would prefer to do more, but cost posed a significant barrier. Interestingly, many parents attributed being active to motivation. As Davis parent said, "[My barrier], a lot of times if I'm being honest, it's kind of a lack of motivation…It's easy to come up with an excuse to do something else." Many parents discussed a lack of motivation as a barrier for both themselves and their families.

Parents mentioned other barriers that their families faced as well. Examples included weather, motivation, the cost of equipment, and electronics. Most parents said that the cold weather and dark early evenings in Michigan made it difficult to go outside and be active. In terms of motivation, Thomas parent said, "Sometimes it is attitude – trying to get someone to go outside with me makes it a little hard." Lee parent stated, "Trying to motivate everybody to put down [their] phone or [their] gaming system or whatever [they're] doing and get up and move can be difficult at times." Johnson parent mentioned drawing their children away from screens: "I think for my husband and I, [barriers are] as we're trying to get the kids to be active is screens. Screen time – you know, trying to pull them away from those."

Children discussed barriers in terms of physical activity. These obstacles included too much schoolwork, not having siblings or friends to play with, motivation, technology and screens, participating in too many activities, and weather. The Smith and Williams child each discussed school as a barrier, namely having too much work and too much online time. In terms of not having siblings to play with, Williams child said, "My siblings don't want to play the game that I'm trying to play or something." Davis child stated that he and his brother were each signed up for multiple activities: "Me and my brother both do piano and Scouts, so it still definitely adds up." Regarding motivation and technology, Lee child said, "There's just some days where I'm, like, really, really tired and don't want to do much except play video games and watch videos." Several children also mentioned the weather, saying that having warm gear (e.g., for outdoor activities) was helpful. Overall, barriers inhibited parents, families, and children from being as active as they desired.

Motivators. Motivators were defined as either something or someone that promotes interest and enthusiasm around participating in physical activity. Focused codes were parent, child, family motivators, and parent role model. Children were parents' greatest motivator. The Brown parent stated their child would ask to go out and run together. Martin parent was an older parent and said they were motivated to stay active to see their children grow up.

Parents also mentioned their children as a motivator when discussing their own roles as parents. Each parent stated they strove to encourage their children's physical activity. Parents specifically discussed encouraging, supporting, and modeling physical activity. Regarding encouragement, parents mentioned occasionally giving their children “a push” to get out the door. Jones parent said, “When I see that they’re spending too much time on their electronics or on the couch or they’re just getting kind of ornery, I am like, ‘OK, let’s get up, we are going outside.’” Similarly, Thomas parent said, “[My son] is fairly active, but sometimes he needs a little support and push to get outside.” Parents of children who participated in organized sports particularly supported physical activity. Taylor parent discussed cheering their child on at games, whereas Martin and Thomas mentioned driving children to and from practices and games. Smith parent, whose child did not participate in organized sports, described supporting physical activity by buying new equipment:

> I got us a jump rope because that is something different we can do and try. Right [now] I am just trying to buy different equipment I find online. I saw this thing online, it’s probably not going on now, but it was like an indoor jungle gym for older kids.

In terms of modeling behavior, parents alluded to the importance of physical activity. Miller parent said:

> I have to demonstrate physically why it’s important, and I have to, you know, put my money where my mouth is – like, I have to do those things, too. I take the kids to the park and I play at the park with them. I’m on the swings, or we play tag and things like that.

Taylor parent echoed this point:

> I think, as a parent, it’s important to me to model [physical activity] so that they see that’s a part of just regular life and then it’s not something that I do in order to look a certain way, it’s not something that I do in order to fit in with a group. It’s just – this [is] how you take care of your body in a very basic way.

Parents were highly motivated by and for their children to be physically active. As discussed above, parents perceived physical activity as a major aspect of life and believed in supporting physical activity while modeling it.

Concerning family motivators, parents and children discussed motivation for scheduling or planning physical activity. They also mentioned the added benefit of being active together. Thomas parent underlined the importance of having a plan: “I think we could probably schedule and have it, like, planned out.” Brown parent said, “When you have a kind of a plan or a specific activity. Right. [Then] it’s a couple of people doing it together. There’s kind of energy between, you know, multiple people to make something happen.” Brown parent highlighted both a plan and the motivator of engaging in physical activity as a family. Williams parent also noted that being together helped encourage their family:

> I definitely notice when we go as a family – say, to the park or to the beach or something – that the kids who usually need encouragement at home don’t need as much encouragement, because we’re all as a group. So, they kind of join in on the fun and foster those relationships.

Davis parent discussed engaging in physical activity as a family but stated that the activity needed to be one that everyone enjoyed: “I think if we were to find activities that we all enjoy doing together.” Put simply, families were motivated when physical activity was scheduled, by completing the activity together, and by ensuring that the whole family enjoyed it.

Children’s greatest motivator was engaging in physical activity with others, such as siblings or friends. Every child interviewed had a sibling with whom they mentioned being active regularly. Physical activities in which children participated with siblings included wrestling in the house, playing soccer outside, riding bikes, and playing frisbee. Martin child discussed being frustrated that his sibling did not want to be physically active more often: “I have to beg [my sister], and she is always on TikTok." Most children also alluded to being physically active with friends. However, many pointed out that they had not seen friends (or had seen a limited number) due to COVID-19. Martin child explained, "In general [before COVID-19], I would be, like, playing outside and I would be playing with my friends and going to baseball practice and going to school every day seeing my friends." When discussing ways to become more active, Smith child said, "I think if I went with my friends – like if we actually, like, went places – I would walk around more." Johnson child mentioned how, if he could not play with friends, then he would ask his sibling: "If I'm not with friends and I can't play with them and I want to, like, do something, I pretty much always go to [my brother]."

Children also discussed how their parents motivated them. Miller child stated that her parents supported physical activity by bringing her on trips to places such as Cedar Point. Johnson child mentioned that it was helpful to see "physical activity" written on his chore list. Taylor child also stated her parents were highly supportive of physical activity:

> Yeah, [my mom] and my dad are both very supportive people. She will be very happy and he will be trying to coach during a basketball game. I swear I hear my dad yell out directions to me. I swear, he yelled at me to do something and [my mom] just kept yelling "Yay!"

Other children mentioned certain physical activities, such as sports, as major motivators. Sports teams represented an activity that was fun, enjoyable, and provided children an opportunity to be with friends. As Thomas parent said about her son, "When it comes to football, he always wants to go." Children were generally motivated by others (e.g., siblings, friends, and parents) to be physically active.

COVID-19. In this dissertation study, the theme of "COVID-19" was defined as any factors affecting physical activity and motor competence due to the pandemic. Focused codes were parent-child work/school status, child PE class, COVID-19 activity level, and COVID-19-specific barriers. Every parent-child dyad had different perceptions of the pandemic's effects on physical activity and motor competence. In terms of work status, two parents (Smith and Taylor) were furloughed due to COVID-19, two continued to work outside the home (Thomas and Anderson), one had had a hybrid in-person/online work arrangement since summer 2020 (Davis), and seven parents had been working from home (Jones, Miller, Williams, Johnson, Brown, Lee, and Martin). Regarding children's school status, one child (Williams) was homeschooled even before COVID-19, two were engaged in in-person learning (Johnson and Davis), two were in learning through a hybrid in-person/online format (Martin and Miller), and seven were learning entirely online (Smith, Jones, Brown, Thomas, Lee, Anderson, and Taylor). When children discussed PE class, they explained that teachers tended not to teach and instead showed pre-recorded videos. Brown child was the only study participant taking an online PE class where the teacher engaged with students:

> Our gym teacher is pretty funny. And he's like – OK, so today he brings out his huge giraffe stuffed animal, "We're going to be doing some dribbling with a giraffe. So, go find your stuffed giraffes." And then we go find our stuffed giraffes, and that is our ball.

Brown child however also said, "Well, there's hardly anything that I like doing in gym these days because it's all just kind of doing it on an iPad and it's kind of hard to see." Other children were not enjoying online PE also. Smith child said about PE class, "…we mostly do like paper assignments. So, I don't really do anything."

In terms of physical activity levels, seven parent-child dyads felt they had been substantially less active during COVID-19 (Smith, Jones, Miller, Thomas, Lee, Martin, and Anderson). Three felt that their physical activity had increased (Williams, Johnson, and Davis), and two parents (Brown and Taylor) felt that COVID-19 had not influenced their physical activity but that their child was much less active. Parents who had been less active cited factors such as not going to the gym, not going to work and moving around the office or attending office wellness programs, and an overall sense that it was more difficult to be active. Martin parent said, "There's definitely a lot more sitting around." On the contrary, Davis parent said:

> So pre-COVID, I would say, maybe I did something twice a week, might have been a walk or it might have been a yoga class. I would do one of those two things maybe 2–3 times a week. Now I would say, six out of the seven days I'm getting in something – usually either a walk or, again, yoga at home, sometimes both.

Several children discussed how COVID-19 had stopped their activities, contributing to a decline in physical activity. Among parent-child dyads who believed they were more active due to COVID-19, Williams parent said, "I would say that [the kids] definitely play outside way more than they did before COVID-19." Johnson parent specifically noted having more time:

> Yeah, we will often go on a walk together or a hike or we'll just walk around the neighborhood or go check out, like, a park in the area. That's something we have been doing, especially during COVID when we have been freer on the weekend and haven't had much stuff to do.

Davis parent also discussed having made great strides since the pandemic due to having fewer commitments and more free time. Two parents (Brown and Taylor) each stated they had not been affected by the pandemic but that their children had been less active because sports were canceled, and their children were not going to school. Brown parent said, "If there weren't a pandemic, after school they would be on the playground for hours just running around and playing, right? But that's not happening now."

COVID-19 served as a major barrier to physical activity and motor competence. Parent-child dyads mentioned the closure of workplaces, schools, and gyms, along with the cancelation of sports and other physical activities, as affecting physical activity. As Anderson parent put it, "The limitations with stuff being closed, that's the biggest thing because we're used to going out and always doing stuff. So, with stuff being closed, that's the biggest limitation." Even parents whose physical activity had increased recognized the constraints of the pandemic and its adverse impacts on physical activity levels and motor competence.

Mixed Methods

Statistical analyses

We adopted a mixed methods explanatory sequential design to further address Aim 4. Specifically, quantitative and qualitative findings were triangulated to clarify participants' beliefs about physical activity and motor competence in parents and children. Table III.6 summarizes how the researcher combined quantitative and qualitative data sources for each research question. Data sources included questionnaires, physical activity data, motor competence data, home environment assessments, and interviews.

Research Question 1: **What are parents' and children's knowledge about, perceptions of, and engagement in physical activity and motor competence?** To examine parents' knowledge, perceptions, and engagement, we integrated the parent questionnaire, physical activity data, motor competence data, home environment assessment, and interviews. Questions from the parent questionnaire pertaining to parents' knowledge included the following (response options presented in parentheses): *Do you feel that there is a difference between physical activity and motor skills?* (yes or no); *How would you define physical activity?* (free response); and *How would you define motor skills?* (free response). The following questions were related to parents' perceptions: *How physically active would you categorize yourself?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Does your child meet the physical activity guidelines of obtaining 60 minutes of moderate to vigorous physical activity every day?* (yes or no); *How* *physically active would you say your child is?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Do you think your child is proficient at motor skills?* (not very proficient, not fairly proficient, neither not proficient nor proficient, fairly proficient, or very proficient); *Do you think your child needs to be more physically active?* (yes or no); and *Do you think your child needs improvements in their motor skills?* (yes or no). One item from this questionnaire was associated with engagement: *What type of vigorous (aerobic) physical activity or sports did you participate in at least twice per week during high school and during ages 18–22 years?* (free response).

To examine children's knowledge, perceptions, and engagement, the child questionnaire, physical activity data, motor competence data, home environment assessment, and interviews were integrated. No questions from the child questionnaire were relevant to knowledge or engagement. The following questionnaire items concerned perceptions (response options presented in parentheses): *Do you feel motor skills are important (i.e., being able to move your muscles/body different ways for sports or games)?* (yes or no); *Do you meet the physical activity guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity?* (yes or no); *How physically active would you categorize yourself?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Do you think you need to be more physically active?* (yes or no); and *Do you think you need to improve your motor skills?* (yes or no).

Research Question 2: What do parents and children identify as the benefits and barriers of physical activity? To examine parents' and children's benefits and barriers of physical activity, physical activity data, motor competence data, home environment assessment, and interviews were integrated. Neither the parent nor child questionnaire contained relevant items.

Research Question 3: How has COVID-19 affected parents' and children's physical activity and motor competence? To examine the impact of COVID-19 on parents, we integrated the parent questionnaire, physical activity data, motor competence data, and interviews. The following parent questionnaire items were considered: self-reported hours spent with one's child on weekdays and weekends before and during COVID-19; *How would you describe your child's physical activity during COVID-19?* (very inactive, fairly inactive, neither inactive nor active, fairly active, or very active); *Has your child been more active during COVID-19?* (yes or no); and *Since COVID-19, have you worked on improving your child's motor skills?* (yes or no). The Godin Leisure-Time Exercise Questionnaire was used to assess parents' physical activity during and before COVID-19. The PAQ-C was used to measure children's physical activity during and before COVID-19.

Triangulation was carried out by integrating the quantitative and qualitative data to make particular claims and assertions about participants' associations of and beliefs about motor competence and physical activity (Maxwell, 2013). During data analyses, the researcher examined the data sources for all participants and then focused on the 12 parents and children who participated in semi-structured interviews. Objective measurements of physical activity and motor competence, along with the selected 12 parent-child dyads' insights, clarified participants' associations of and beliefs about physical activity and motor competence.

Results

Descriptive statistics. In total, 61 parents and 59 children completed the questionnaire; 50 parents and 48 children had physical activity data; and 43 parents and 45 children had motor competence data.

All data sources were integrated between the 12 parents and children who took part in semi-structured interviews. The 12 parent-child dyads who completed semi-structured interviews also completed the questionnaires. Eleven parents and 11 children had valid motor competence and physical activity data. The Anderson parent-child dyad had no measurable jumps or validated physical activity data. Twelve parents and 10 children had complete perceived competence data; Johnson and Taylor child did not complete the Perceived Competence section of the questionnaire.

Results. The quantitative data sources were integrated to further investigate Aim 4. All questionnaires, physical activity data, motor competence data, and interviews were examined. Tables IV.31 and IV.32 summarize the integration of all data sources for the 12 dyads who participated in semi-structured interviews.

Research Question 1. Parents demonstrated knowledge of physical activity and motor competence based on their questionnaire responses and interviews. In response to the question "Do you feel there is a difference between physical activity and motor skills?", 90.2% (55/61) of parents responded affirmatively. Parents accurately defined physical activity and motor skills in the free-response format. Interestingly, 34% (21/61) of parents defined physical activity as more in line with exercise (i.e., aerobic exercise; exercising). Some parents' definitions of motor skills were broad and difficult to examine (i.e., hands and feet; activity requiring motion). Even so, these responses did not suggest that parents did not understand the question, which was broad and did not specify gross motor skills. Next, we examined the physical activity and motor skill definitions between the questionnaires and interviews (see Table IV.25). Parents' definitions of physical activity and motor skills aligned across both contexts, reflecting accurate knowledge. No major discrepancies were noted, other than the interview responses being more detailed.

Table IV.25. Mixed methods analysis of parents' physical activity and motor skill definitions.

Parent	Questionnaire PA definition	Interview PA definition	Questionnaire MS definition	Interview MS definition
Smith	Moving body at a rate it gets one's heart pumping quickly.	As far as that I would just say anything that gets your heart rate going or working up a sweat.	Somewhat like range of motion and connecting to what you are doing.	No response
Jones	Movement to get heart rate up.	Means moving and being less stationary, really less lazy.	Ability to move about.	More like coordination and doing things in a certain manner.
Miller	Any movement you engage in.	To get up and get moving and use your large muscle groups.	The ability to control your movement in a coordinated way.	The muscle coordination you have in your body, whether it's fine motor skills like fingertip touching or large motor skills of using your arms and your legs.
Williams	Moving your body in a way that exercises the heart and internal muscles of my body. This usually lasts for at least 15 minutes and involves sweating and increased respiration rates.	Physical activity means moving your body in a way that will elevate your heart rate beyond its resting point.	To move your body that can be performed over and over or just one time. For example, a motor skill might be to climb steps without holding onto the railing. This is a skill that babies cannot do but will learn to doing the first five years of life.	Motor skills are, can you throw a ball? Can you kick a ball? Can you write with a pencil? Can you hop on one foot? These come with age.

Johnson	Moving at all.	I think there's really kind of two components to physical activity. One is like the general movement you do throughout the day. Like, some people just move more than other people move and then there is also an exercise component. Whether you, like, actually work out and you know, have a strict training plan or do cardio to raise your heart rate or whatever.	Movement with a specific goal.	It's the ability to use your body to like to accomplish a certain task, whether it's running down the road or throwing a ball or kicking a ball or, you know, shooting a basketball.
Brown	Intentional movement.	Really just anything moving around. But I would say I tend to think of it as something intentional, as opposed to just moving because I'm doing my stuff around the house but like an intentional activity.	Abilities and function.	I guess I would have said kind of the component parts. Like more foundational, such as bending your legs, balance, like some of those kinds of things, but I mean, obviously I don't really know.
Davis	Exercise that gets your heart rate above average.	Um, so, physical activity is, you know, moving around, moving your body, exercising. That's pretty, pretty much.	Ability to complete specific motor tasks.	Being able to have a good range of motion with all of your muscle groups. Yeah, that's good.
Thomas	Increased heart rate and respiratory rate increased metabolic sweating.	Being active.	Movement with purpose.	Add your ability to do things running, jumping, throwing.
Lee	How much effort you need to exert to get your body going.	Pretty much trying to keep your heart rate up past resting by doing things and working.	The ability to use hand/eye coordination to perform a task (catch, throw, jump, etc.).	Typically, like hand-eye coordination, usually dribbling a basketball, you know, being able to you know actually push it down and receive it when it comes up and your ability to do that.

Martin	Moving with a purpose or goal and not sitting.	To me it means exercise. It also means sports. It means staying healthy, it means keeping everything…Yeah, mostly staying healthy, moving, running, sports.	Your body's movement and muscle movement to do different sports or different activities.	Motor skills – so fine motor would be writing me a note. But, you know, big motor skills are like the videos we did such as throwing the ball, catching the ball, our balance. How well we balance on one leg versus the other and strength in one part of your body versus the other. So yeah, your ability to go on the skateboard, to ride a bike or play on the playground.
Anderson	Physical activity is moving and getting your heart rate up.	Physical activity to me means to move around. Get your heart and muscles moving.	Motor skills are skills that utilize the body and mind.	Motor skills are the skills you need to do the physical activity.
Taylor	Physical activity is purposeful or ancillary movement of the body that can result in physiological benefit/change.	I think to me it just means finding a way to move that works for you. Just definitely moving.	Motor skills demonstrate the ability to perform specific movements.	I think a motor skill is a particular set of movements to accomplish something, whether it's a big or small, so you can either just do bicep curls, and that would be a motor skill, sort of, but I guess when I hear motor skill it seems more particular to achieving some sort of goal, whether it's small, or, you know, like a big, complex movement.

Note: PA = physical activity; MS = motor skills.

The questionnaires, physical activity data, and interviews demonstrated that parents had accurate self-perceptions of their physical activity. In response to the question, "*How physically active would you categorize yourself?"* 0% (0) said they were very inactive, 28% (14) said fairly inactive, 22% (11) said neither inactive nor active, 38% (19) said fairly active, and 12% (6) said very active. Parents' actual physical activity demonstrated that they were fairly active overall: 50% of parents who completed the questionnaire and had physical activity data responded that they were fairly or very active. On average, parents obtained 45.06 minutes per day of moderate physical activity and 5.49 minutes per day of vigorous physical activity. Semi-structured interviews further confirmed that parents had accurate self-perceptions of their physical activity. Parents' physical activity data confirmed their relevant perceptions reported on the questionnaire and in interviews. Three parents (Jones, Williams, and Davis) perceived themselves as much less active on the questionnaires; still, their actual physical activity data were fairly high (>47 minutes of MVPA per day). In their three interviews, these parents had highly positive perceptions about physical activity and discussed being fairly active themselves, thus contradicting their questionnaire responses. One parent (Thomas) perceived themselves as fairly active but only had 22 minutes of MVPA per day. In the interview, Thomas parent discussed not being as active due to COVID-19 restrictions. This parent had been affected by gyms being closed and monitoring their children's online schooling at home. The parent questionnaire contained no questions about parents' self-perceptions of motor competence, and few parents directly discussed their motor competence levels when interviewed. However, among the 12 parents who completed the interview, scores on the perceived competence domain of athletic competence were moderate (M = 1.99). Motor skills were discussed positively during the interviews as well.

The questionnaires, actual physical activity data, and interviews revealed that parents had inaccurate perceptions about their children's physical activity and motor competence. A chi-square test for independence was used to examine the extent of agreement between the question, "*Does your child meet the physical activity guidelines of obtaining 60 minutes of moderate to vigorous physical activity every day"* and if the child "met" or "not met" the physical activity guidelines of accumulating 60 minutes of MVPA per day (see Table IV.26). Responses to these questions were inconsistent [$\chi^2(1) = 2.80$, $p > .05$]. Another chi-square test for independence was conducted to examine the extent of agreement between the question, "*How physically active would you say your child is?"* and whether the child met the physical activity guidelines of accumulating 60 minutes of MVPA per day (see Table IV.27). To compare these variables, we dichotomized parents' perceptions of their child's physical activity as "agree" and "disagree." Follow-up sensitivity analyses were performed to assess the effect on chi-square test results if neutral answers were categorized as "agree" rather than "disagree." Responses to these questions were consistent when neutral responses were labeled "disagree" [$\chi^2(1) = 6.53$, $p = .01$]; the two questions did not coincide when neutral responses were labeled "agree" [$\chi^2(1) = 3.69$, $p > .05$]. In the "disagree" scenario, 62% of parents inaccurately categorized their child as active, whereas 69% of parents inaccurately categorized their child as active in the "agree" scenario. Once neutral responses were removed, 19 parents categorized their child's physical activity as fairly or very active, although the levels did not meet physical activity guidelines. Interviews further confirmed that parents inaccurately perceived their children's physical activity. Four parents vastly overestimated their children's physical activity according to the questionnaire and interview (Davis, Thomas, Lee, and Taylor). Lee parent said, "Well, we don't typically have to worry about [our child] because the minute he has his friends come over, he is off running around the neighborhood, having fun, playing sports, and whatever else they're doing." However, Lee child only had an average of 30 minutes of MVPA per day; Davis child had an average of 27.76, Thomas child had an average of 16.15, and Taylor child had an average of 28.34 minutes of MVPA per day. Two parents accurately perceived their children as having low levels of physical activity (Smith and Anderson). All other parents categorized their child as active during interviews.

Table IV.26. Crosstabulation of agreement between parents' perceptions of children meeting physical activity guidelines and if their child met physical activity guidelines.

	Does your child meet the physical activity guidelines?		
MVPA met	No	Yes	Total
No	22	14	36
Yes	4	8	12
Total	26	22	48

Table IV.27. Crosstabulation of agreement between parents' perceptions of children's physical activity levels and if their child met physical activity guidelines.

	MVPA not met	MVPA met
Neutral responses categorized as *disagree*		
Parent perception: child inactive	18	1
Parent perception: child active	18	11
Neutral responses categorized as *agree*		
Parent perception: child inactive	9	0
Parent perception: child active	27	12

Parents generally overestimated their children's motor competence across questionnaires, interviews, and actual motor competence data. On the questionnaire, 75% of parents (46) responded that their child was "fairly proficient" or "very proficient" in terms of motor skills. Comparing this percentage to actual motor competence scores, we observed a large range in process (i.e., 6–28 points) and product scores (i.e., 0–100% for catch percentage and 0–154 cm for jump distance); thus, most children were neither fairly nor very proficient. Interviews also confirmed that parents overestimated their children's motor competence, as all parents who discussed their children's motor competence perceived their children as skilled. However, motor competence scores varied for children who participated in the interviews as well.

Children's perceptions of their physical activity and motor competence were not consistent across all data sources. Their questionnaire and interview responses indicated that motor skills seemed important. In response to the question *"Do you feel motor skills are important (i.e., being* *able to move your muscles/body different ways for sports or games)?"*, 96.6% of children (57) responded affirmatively. During interviews, once "motor skills" were defined, all children considered them important. The questionnaires revealed that children generally overestimated their own physical activity. In response to the question *"Do you meet the physical activity guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity every day?"*, 73% (35 of the 48 children with physical activity data) said "yes," but only 12 met physical activity guidelines. In response to the question "*How physically active would you categorize yourself?"*, 4.2% (2) children responded "very inactive," 12.5% (6) said "fairly inactive," 6.3% (3) said "neither inactive nor active," 43.8% (21) said "fairly active," and 33.3% (16) said "very active." Children also overestimated their physical activity levels; the mean MVPA per day was moderate at 47.48 minutes, while 77% of children categorized themselves as fairly or very active. However, when integrating all data sources, children's self-perceptions of their physical activity were fairly accurate: seven of the 12 children interviewed accurately described their physical activity levels. Only four children (Davis, Thomas, Lee, and Williams) inaccurately perceived their physical activity across all data sources. Davis, Thomas, and Lee children overestimated their physical activity on the questionnaire and during interviews compared with their actual physical activity data. Davis child responded on the questionnaire that he was fairly active but only had an average of 28 minutes per day. Davis discussed being on a baseball team and believed he did well with physical activity. Thomas responded on the questionnaire that he was fairly active; however, he only averaged 16 minutes per day. Lee responded on the questionnaire that he was very active but only totaled 26 minutes per day. As discussed above, Davis, Thomas, and Lee parents also inaccurately perceived their children's physical activity on the questionnaire and during interviews. Williams child underestimated her physical activity, stating on the questionnaire that she was fairly inactive; however, her actual physical activity data revealed 47 minutes of MVPA per day on average. During the interview, she discussed how physical activity was her favorite activity and that she was active all the time. Children's perceptions of their motor competence also did not coincide across all data sources. On the question *"Do you think you need to improve your motor skills?"*, 46.7% (21/45) of children who had motor competence data responded that they needed to improve these skills. When examining the questionnaire responses of children who were interviewed, four (Smith, Williams, Johnson, and Davis) responded that they did not need to improve their motor skills. Williams, Johnson, and Davis had some of the highest motor competence scores across all children. Smith child was the only child interviewed who inaccurately perceived their motor competence on the questionnaire. During interviews, children spoke positively about their motor competence and mentioned having high skill levels, although motor competence in fact varied across the 12 children.

Congruence in parents' and children's perceptions of physical activity and motor competence was also examined across questionnaires and interviews. Chi-square tests for independence were used to examine the extent of agreement between parents' perceptions that their child needed to be more physically active and children's self-perceptions about being more physically active (see Table IV.28). Parents' perceptions about their child needing to be more physically active and children's self-perceptions of needing more physical activity were similar [$\chi^2(1) = 8.88$, $p = .003$]. Interestingly, 10 more parents than children answered "no." Chi-square tests for independence were used to examine the extent of agreement between parents' perceptions that their child needed to improve their motor skills and children's self-perceptions of needing to improve their motor skills (see Table IV.29). Parents and children perceived children's motor competence similarly [$\chi^2(1) = 6.17$, $p < .05$]. Only one parent-child dyad disagreed with the need to improve motor skills. One parent responded that their child did not need to improve their motor skills, whereas the child responded that they did need to improve their motor skills. Throughout interviews, parents and children generally agreed about children's physical activity levels and motor competence. Two parents and their two children (Smith and Anderson) perceived the child's physical activity levels as low. In comparison, three parents and their children (Davis, Thomas, and Lee) perceived the child's physical activity levels as high. The other parents and children mostly agreed about the child's physical activity and motor competence, even if such agreement was inaccurate based on actual physical activity and motor competence data.

Table IV.28. Crosstabulation of agreement between parents' perceptions of their child needing more physical activity and child's own perception of needing more physical activity.

	Do you think you need to be more physically active?		
Do you think your child needs to be more physically active?	Yes	No	Total
Yes	2	14	16
No	24	19	43
Total	26	33	59

Table IV.29.Crosstabulation of agreement between parents' perceptions of their child needing to improve motor skills and child's own perception of needing to improve motor skills.

	Children's perception		
Parents' perception	Yes	No	Total
Yes	11	19	30
No	20	9	29
Total	31	28	59

For parental engagement, we observed partial agreement across all data sources. Parents indicated on the questionnaire that they had engaged in various activities during high school and between ages 18 and 22. Activities included but were not limited to running, soccer, marching band, and cheerleading. However, these activities were not directly associated with parents' current physical activity levels or motor competence. This lack of association persisted when integrating data sources. Engagement varied across the three parents (Brown, Taylor, and Thomas) with the highest motor competence scores; Brown parent had the highest score out of the 12 parents interviewed but only had 27.43 minutes of MVPA per day on average. In their interview, Brown parent discussed playing frisbee, playing soccer, going on hikes with their family, and being an avid runner. Interestingly, Brown did not participate in physical activities or sports during high school or ages 18–22. Taylor parent was a fitness and yoga instructor who was highly active (M = 66.20 minutes of MVPA per day). Taylor parent played basketball and softball in high school and stayed active at 18–22 years old. Thomas parent played softball in high school and had high perceived motor competence from 18 to 22 years old but had low physical activity (M = 22.15 MVPA per day). The three interviewed parents with the lowest motor competence scores (Smith, Williams, and Johnson) had lower perceived competence scores but were each fairly active and discussed such activity throughout interviews. Smith parent did not participate in physical activity or organized sports during high school or ages 18–22. By contrast, Williams parent did track and marching band, and Johnson parent did track and cheerleading. Overall, when examining responses based on physical activity data, motor competence data, and interviews, parents with higher physical activity and motor competence levels mentioned engaging in various forms of physical activity independently and with family.

We also observed partial alignment across all data sources on children's engagement. Out of the 12 children interviewed, all discussed engaging in physical activity and motor competence activities. Additionally, seven played on organized sport teams but did not have higher physical activity levels than the other children. However, these seven children's motor competence scores surpassed those of the other children.

Research Question 2. Physical activity data, motor competence data, interviews, and home environment assessments were similar in terms of benefits and barriers. All 12 parents and children, regardless of physical activity levels and motor competence, noted the benefits and barriers of physical activity and motor competence during interviews. The home environment assessment did not provide in-depth information in this regard; nearly all participants (10/12) lived in single-family homes with access to ample space and equipment.

Research Question 3. Questionnaire and interview responses were discrepant regarding the impact of COVID-19. Using questionnaire responses, *t*-tests were carried out to examine parents' self-reported hours per day spent with their children on weekdays and weekends during COVID-19 versus before COVID-19. T-tests were also used to examine differences in parents' and children's self-reported physical activity during and before COVID-19. Parents reported spending significantly more hours with their children on weekdays during COVID-19 ($M = 14.26 \pm 10.15$) versus before ($M = 8.39 \pm 8.56$); [$t(120) = -3.46$, $p < 0.001$]. No statistically significant effect emerged for parents' reported hours on weekends during COVID-19 ($M = 15.80 \pm 6.04$) compared to before COVID-19 ($M = 15.11 \pm 6.19$); [$t(120) = -0.622$, $p = 0.54$]. Similarly, we found no statistically significant effect of parents' perceived physical activity during ($M = 2.66 \pm 0.68$) and before COVID-19 ($M = 2.62 \pm 0.71$); [$t(120) = -0.26$, $p = 0.80$]. No statistically significant effect was noted for children's perceived physical activity during ($M = 2.75 \pm .73$) and before COVID-19 either ($M = 2.60 \pm 0.70$); [$t(116) = -1.12$, $p = 0.27$].

Chi-square tests for independence were used to examine the extent of agreement between parents' perceptions of their child's physical activity level during versus before COVID-19. Parents perceived their child's physical activity level similarly [$\chi^2(16) = 48.5$, $p < 0.001$]; see Table IV.30). Despite this congruence, 12 more parents responded that their child was "fairly inactive" and 10 fewer parents responded that their child was "fairly active" during COVID-19 compared to before COVID-19. When presented with the question *"Has your child been more active during COVID-19?*", 69% of parents responded "no" and 31% responded "yes."

Table IV.30. Crosstabulation of parents' agreement of perceptions of child's physical activity during compared to before COVID-19.

	Child physical activity level during COVID-19					
Child physical activity level before COVID-19	Very inactive	Fairly inactive	Neutral	Fairly active	Very active	Total
Very inactive	0	1	0	0	0	1
Fairly inactive	1	9	1	0	1	12
Neutral	0	5	4	4	0	13
Fairly active	0	9	6	11	1	27
Very active	0	0	0	2	6	8
Total	1	24	11	17	8	61

Upon combining questionnaire and interview data, we examined responses on the Godin Leisure-Time Exercise Questionnaire during and before COVID-19 among the 12 parents who engaged in interviews. Many parents' subjective ratings of physical activity remained consistent during and before COVID-19. Two parents, Miller and Davis, reported an increase. Miller mentioned having been moderately active before COVID-19 and active during COVID-19, whereas Davis mentioned having been insufficiently active before COVID-19 but active during. Martin and Lee parents reported declines in physical activity: Martin stated they were insufficiently active before COVID-19 and moderately active during, whereas Lee said they were moderately active before COVID-19 and insufficiently active during. We also examined children's responses on the PAC-Q during and before COVID-19. Most children's subjective physical activity was similar. However, Jones and Thomas children reported an increase while Lee, Davis, and Taylor children reported a decline.

All participants' Phase I questionnaire responses, the 12 parent-child dyads' subjective reports of physical activity, and interview commentary differed slightly. In interviews, seven parent-child dyads discussed declines in physical activity since COVID-19 (Smith, Jones, Miller, Thomas, Lee, Martin, and Anderson), and three parent-child dyads stated that their physical activity had increased (Williams, Johnson, and Davis). Two parents (Brown and Taylor) felt that COVID-19 had not influenced their physical activity but that their children were much less active. Lee and Taylor parent-child dyads were the only ones to accurately report their physical activity levels and address them accurately in interviews.

Table IV.31. Mixed methods analyses for each parent who participated in all phases.

Parent	Questionnaire perception self	Questionnaire perception child	MVPA (average min/day)	MC (z-score)	PC-AC	Interview Perception Self and/or Child PA and/or MC
Smith	*Physical activity*- Very active	*Physical activity*- Fairly inactive *Motor skills*- Not fairly proficient	54.07	-1.26	1.25	▪ *I do not think [Smith child] is active at all. At all. She is just not active. If I really push her do something and say "We're going to do this," you know, to get physical activity she will drag her feet, but once she does it, she does get enjoyment while she's doing it. But it's just actually getting there. That is the hard part for her.*
Jones	*Physical activity*- Neither inactive nor active	*Physical activity*- Fairly active *Motor skills*- fairly proficient	47.19	-0.84	1.25	▪ *I enjoy physical activity. I wish I had more time to do more physical activity. It just seems like time is so strapped these days.* ▪ *Yeah, I think we're all skilled.*
Miller	*Physical activity*- Neither inactive nor active	*Physical activity*- Fairly inactive *Motor skills*- Neither not proficient nor proficient	37.74	1.25	2.5	▪ *Our younger child is the most physically active in the house. She is constantly up and down the stairs [and] in and out of the house. And just finds ways to make herself move and dance and stuff. And then I would be next in line with physical activity because I think I tend to follow with her, to go on those walks and things and then [Miller child] would be third active and then the father of the household is the least active.* ▪ *As far as coordination I don't know, the kids are pretty equal.*
Williams	*Physical activity*- Fairly inactive	*Physical activity*- Fairly active *Motor skills*- Fairly proficient	48.82	-2.21	1.50	▪ *I think there's a couple of things about that. We have five kids and I would say two of the five need encouragement, but three of the five are very much active and are very much "Can we go outside? Can we play basketball? Can I go on the swings?"* **Williams child:** *I am one of the three?* **Williams parent:** *Yes you are.*
Johnson	*Physical activity*- Fairly active	*Physical activity*- Fairly active	81.86	-3.58	2.25	▪ *I do enjoy being physically active throughout the course of the normal things that I do. I don't specifically enjoy exercising, although I am pretty*

		Motor skills- Very proficient				*religious about exercising. I work out usually like six days a week [weightlifting and cardio].*
Brown	*Physical activity-* Fairly inactive	*Physical activity-* Fairly active *Motor skills-* Fairly proficient	27.43	2.88	1.50	▪ *My perception is that they're quite a bit less active [but still fairly active] now because if it – if there weren't a pandemic, after school they would be on the playground for hours just running around and playing, right? But that isn't happening now.* ▪ *I also run about three or four days a week now.* ▪ *I would say both of the kids are pretty solid athletically and my husband also.*
Davis	*Physical activity-* Neither inactive nor active	*Physical activity-* Neither inactive nor active *Motor skills-* Fairly proficient	55.95	-0.02	1.50	▪ *Um, so I do feel like since COVID, since March, we've actually taken a huge step forward and that I would say if you were talking to us a year ago, I would say we were probably not very good models and not very good at, like, making time and finding opportunities to do that. But I do feel like since COVID we've been a lot better modeling physical activity. But before that, I would have said, other than like taking the kids to practices, we were not that active. We would belong to gyms and go and work out, but that never lasted more than a couple weeks or something.*
Thomas	*Physical activity-* Fairly active	*Physical activity-* Neither inactive nor active *Motor skills-* Fairly proficient	22.15	2.08	3.67	▪ *I enjoy it. I miss going to the gym.* ▪ *Um, fairly active – sometimes he needs a little support and push to go outside, but when it comes to football, he's fine. He wants to go.* ▪ *He is a lot more skilled than his sister.*
Lee	*Physical activity-* Fairly inactive	*Physical activity-* Very active *Motor skills-* Very proficient	30.62	0.71	1.50	▪ *Generally, I love it. But I find it hard to make time to do it.* ▪ *Well, we don't typically have to worry about [Lee child] because the minute he has his friends come over, he is off running around the neighborhood, having fun, playing sports, and whatever else they're doing.* ▪ *[In regard to increasing family physical activity]: Definitely need to be more active, for sure.*

Martin	*Physical activity-* Fairly active	*Physical activity-* Fairly active *Motor skills-* Fairly proficient	55.10	1.49	1.50	▪ *I love to run. So that's just my thing. They all have sports and that's my thing.* ▪ *I think we're all pretty active and the kids are skilled at their sports.*
Anderson	*Physical activity-* Fairly inactive	*Physical activity-* Fairly active *Motor skills-* Very proficient	--	*Process score -2.11*	2.75	▪ *Okay, I'm fine with physical activity, I really love to dance. So that's where I get my most physical activity or walking.* ▪ *Yeah, the last couple weeks she hasn't really been motivated to pretty much do anything. She'll go to school, but after she's ready to go to bed. She hasn't even really been watching her TikTok videos like she normally does. But when she's not in this fatigue state, she's usually dancing and moving around a lot, playing around, or playing around with her toys in her room or in my living room.* ▪ *She can do things like walk in place and stuff, she's just being lazy.*
Taylor	*Physical activity-* Very active	*Physical activity-* Neither inactive nor active *Motor skills-* Fairly proficient	66.20	2.13	2.75	▪ *I think my perceptions of my own is good, like I'm not the most coordinated person, but I do enjoy it. And so, I try to find ways that feel uncoordinated and work on those. But I think I have a pretty healthy outlook on it.* ▪ *My child is very active.*

Note. MVPA = moderate to vigorous physical activity; MC = motor competence; PC = perceived competence; AC = athletic competence; No physical activity or motor competence data for Anderson parent (only a process z-score).

Table IV.32. Mixed methods analysis for each child who participated in all phases.

Child	Questionnaire perception	MVPA (average min/day)	MC (z- score)	PC-AC	Interview perception of PA and/or MC
Smith	*Physical activity:* Fairly inactive *Motor skills:* No	14.45	-0.89	3.33	▪ *Sometimes it's okay. Like if I feel like doing it like or if [my mom] lets me pick what I can do or when I can do it. But like sometimes, like, I don't really want to do it and then I have to do it anyways.* ▪ *I guess … I don't really like it because I would rather like to do other things and it's just like, I don't really see, like, a point to it. It's like, to me or anything.*
Jones	*Physical activity:* Fairly active *Motor skills:* Yes	47.89	-1.30	2.00	▪ *I kind of enjoy it because it is a way to kind of get all of your energy out, especially when you have been sitting down for a long time. You kind of get all of that out of you and all of that energy.*
Miller	*Physical activity:* Fairly active *Motor skills:* Yes	44.63	-2.08	1.83	▪ *I think my sister is probably the one of us that wants to be active most because, like, she is the one that goes out and plays on a trampoline the most and she's the one that's always asking us to go to the park or go on a walk.*
Williams	*Physical activity:* Very inactive *Motor skills:* No	47.30	-0.73	3.33	▪ *[Physical activity] is probably one of my favorite things to do.*
Johnson	*Physical activity:* Fairly active *Motor skills:* No	50.87	1.75	--	▪ *If I'm, like, running on a treadmill I don't really like doing that. I like doing stuff with other people. Like, I like doing it with other people and I like it the most when I'm doing it with friends, but I also like to shoot hoops and stuff like that [by myself], and I'll be fine with it.* ▪ ***Sports teams:*** *basketball & baseball*
Brown	*Physical activity:* Fairly active *Motor skills:* Yes	58.10	1.41	2.17	▪ *Yes, pretty active.* ▪ *I was on [the] soccer team. That is not really happening anymore. And my school did this running thing with tons of different kids from the school where you run around their soccer fields and you get these little mini feet things.* ▪ ***Sports teams:*** *soccer & running clubs*
Davis	*Physical activity:* Fairly active	27.76	2.97	3.33	▪ *I feel like I do pretty good with, like, doing gym at school and then practicing baseball for four hours a week, I feel like I did pretty*

	Motor skills: No				*good with [physical activity].* ▪ ***Sports teams:*** *baseball*
Thomas	*Physical activity:* Fairly active *Motor skills:* Yes	16.15	1.82	3.00	▪ *Um because if we didn't have physical activity, we wouldn't really be doing much at all.* ▪ Thomas parent: *Do you think there are some days you could do better [being physically active]?* Thomas child: *Yes* ▪ ***Sports teams:*** *football*
Lee	*Physical activity:* Very active *Motor skills:* No	26.03	2.77	3.17	▪ *I enjoyed a lot. I do it many times a day. [in regard to physical activity]* ▪ ***Sports teams:*** *football and baseball*
Martin	*Physical activity:* Very active *Motor skills:* Yes	67.87	2.39	2.67	▪ *Um, I like it. But sometimes when you have basketball three days a week it's not that fun. But yeah, I like it.* ▪ ***Sports teams:*** *basketball and baseball*
Anderson	*Physical activity:* Fairly inactive *Motor skills:* Yes	--	*Process score -1.22*	3.6	▪ *I think [physical activity] is fun.* ▪ *How do you think about your physical activity levels?* Anderson child*: Poor.*
Taylor	*Physical activity:* Fairly inactive *Motor skills:* Yes	28.34	1.17	--	▪ *I enjoy when I do things I like.* ▪ *I think I'm active enough.* ▪ ***Sports teams:*** *horseback riding, basketball, swim*

Note. MVPA = moderate to vigorous physical activity; MC = motor competence; PC = perceived competence; AC = athletic competence; Anderson child had no physical activity or motor competence data (only a process z-score).

Discussion

Semi-Structured Interviews

For the first part of Aim 4, we sought to understand parents' and children's beliefs about physical activity and motor competence via semi-structured interviews. These interviews offered insight into parents' and children's physical activity and motor competence through seven themes: knowledge, perceptions, engagement, benefits, barriers, motivators, and COVID-19. For knowledge, we found that parents tended to possess accurate knowledge about physical activity and motor skills. These findings align with previous qualitative research by Thompson et al. (2010) along with quantitative research by Scott-Andrews et al. (in review) and Jarvis et al. (2020). Thompson et al. (2010) interviewed parents, who appeared knowledgeable about physical activity and considered it essential for themselves and their families. In an online survey, Scott-Andrews et al. (in review) found that parents accurately identified a difference between physical activity and motor skills and responded that motor skills were important to physical activity participation. Jarvis et al. (2020) discovered that parents deemed motor development a key aspect of physical activity and facilitated such participation. The findings from these studies demonstrate parents' knowledge of physical activity and motor skills. Thus, other factors seem to impede physical activity levels in parents and children. We found that children defined physical activity as analogous to exercise and working out regarding children's knowledge. Children could not define motor skills. Given the limited research examining beliefs about motor skills, especially in children, these results speak to the importance of educating children about the components of physical activity and motor skills.

Parents and children held positive perceptions of physical activity, including for mental and physical health. Parents and children discussed how much they enjoyed physical activity as long as they were participating in activities they liked. Relatedly, Brown et al. (2015) pointed out that physical activity should be fun; they held focus groups with 17 families and found that children wanted to take part in physical activity interventions involving activities they enjoyed. In a perspective piece, Barnett et al. (2019) discussed the importance of physical activity enjoyment in supporting physical activity behavior. Research has also revealed that physical activity enjoyment can increase and maintain physical activity levels in adults and children (Barnett et al., 2019). Overall, enjoyment has been largely overlooked in physical activity research but should be prioritized (Barnett et al., 2019). Findings from our semi-structured interviews substantiate the role of physical activity enjoyment.

Parents perceived their children as fairly active. Children also perceived themselves as having high levels of physical activity. Only two parents (Smith and Anderson) perceived their children as having low levels of physical activity, and their children also perceived their physical activity levels as low. Regarding parents' perceptions of their children's motor competence and children's perceptions of their motor competence, no parents or children mentioned low motor competence. Research has shown that parents often overestimate their children's physical activity levels during interviews (Bentley et al., 2012; Kesten et al., 2015). No qualitative studies have yet been conducted regarding parents' perceptions of motor skills, but the results from quantitative studies are mixed concerning parents' perceptions of their children's motor competence (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015; Silvia et al., 2017; Zysset et al., 2018). Therefore, parents and children may have overestimated children's physical activity and motor competence levels in this study.

Every parent and child discussed engaging in physical activity and motor skills to some extent. All families had equipment and access to spaces that supported physical activity. The family who lived in an apartment stated that their access was more limited but did not perceive this factor as a barrier. Parents and children both discussed a variety of activities in which they engaged. All parent-child dyads mentioned enjoying being physically active as a family and regularly participated in activities together for family engagement.

Parents and children discussed the benefits and barriers of engaging in physical activity. Parents' cited benefits involved health and engaging in physical activity together; those cited by children pertained to health, feeling good, and the opportunity to play with friends and/or family. Barriers mentioned by parents for themselves were time, health issues, weather, cost, and motivation. Barriers mentioned for their families were weather, lack of motivation, the cost of equipment, and electronics. Children's noted barriers included schoolwork, not having siblings or friends to play with, lack of motivation, technology/screens, too many activities, and weather. However, when parents and children discussed physical activity engagement, the benefits outweighed the barriers; parents and children regularly participated in physical activity and motor competence activities (e.g., sports and outside games).

Parents and children also addressed motivators to physical activity. Parents' prime motivator was their children. Children motivated parents explicitly by persuading them to complete activities together and more implicitly through the desire to be positive role models. Parents also referred to the family motivator of completing activities as a family. For children, the greatest motivator was engaging in activities with others, such as friends or siblings. These motivators (across parents, families, and children) echoed those identified by Moore et al. (2010). Moore et al. (2010) conducted focus groups with middle-school students and their parents about physical activity beliefs. The parents discussed the importance of being a role model, while children identified social outlets as one of the greatest influences. Lack of motivation is a barrier to physical activity; thus, it is imperative to incorporate these motivators to support physical activity in parents and children.

In terms of the "COVID-19" theme, this study provides novel insight into the pandemic's impacts on parents' and children's physical activity and motor competence. To our knowledge, this is one of the first studies to explore parents' and children's experiences with COVID-19 concerning its effects on physical activity and motor competence. In particular, all parent-child dyads had unique experiences with the pandemic. Overall, most dyads perceived a decline in physical activity with COVID-19 as the most significant barrier. Decreased activity was attributed to the cessation of routine daily activities, such as going to work/school and structured physical activities (e.g., running club, baseball practice). These negative impacts of COVID-19 corroborate recent studies indicating that quarantine and isolation lowered physical activity (Ammar et al., 2020; Tulchin-Francis et al., 2021). In fact, total step count decreased globally during the first few months of the pandemic (Tison et al., 2020). Preliminary findings from the United States, have found that children's physical activity levels significantly decline during COVID-19 (Tulchin-Francis et al., 2021). Children's PE experiences were also highly informative: most children in online school did not have live PE classes; instead, PE teachers used pre-recorded videos, which children did not enjoy.

Interviews also showed that parents and children possessed accurate knowledge, positive perceptions, and engagement in physical activity and motor competence activities. However, parents and children both overestimated children's physical activity and motor competence. Parents were largely motivated to be active thanks to their children, whereas children were motivated by the social influence of friends and siblings. Parents believed they were role models in encouraging physical activity in their children. Benefits and barriers varied between parents and children as well. COVID-19 had negatively impacted physical activity and motor competence in parents and children by interrupting everyday life. However, families' COVID-19 experiences differed drastically, with participants pointing out certain benefits. Interviews thus offered novel information on parents' and children's beliefs about physical activity and motor competence.

Mixed Methods Triangulation

Integrating quantitative and qualitative data sources provided the opportunity to further understand parents' and children's associations of and beliefs about physical activity and motor competence. Having multiple data sources permitted triangulation, ensuring that the claims and assertions made in this study aligned with parents' and children's actual experiences.

Parents demonstrated knowledge about physical activity and motor competence on the questionnaires and in interviews. These findings support prior qualitative research (Thompson et al., 2010) and quantitative studies (Haddad et al., 2018; Jarvis et al., 2020; Scott-Andrews et al., in review). Parents had accurate self-perceptions about their physical activity, different from research indicating that adults (Celis-Morales et al., 2012; Skender et al., 2016) inaccurately reported physical activity behavior and tended to overestimate their physical activity on self-report measures. Such overestimation may be attributed to the sample included in this study, as all parents were relatively active.

All data sources confirmed that parents held inaccurate perceptions about their children's physical activity and motor competence. These findings corroborate quantitative work showing that parents generally overestimate their children's physical activity (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020) and motor competence (Silva et al., 2017). These findings also align with two qualitative studies that examined parents' perceptions of their children's physical activity. Kesten et al. (2015) found that parents overestimated their children's physical activity levels during interviews versus objectively measured physical activity; Bentley et al. (2012) found that parents tended to categorize their children as either very active or active during interviews.

We noted that children overestimated their physical activity levels on questionnaires but were more accurate when discussing their physical activity levels during interviews. This overestimation echoes prior literature involving self-report measures (LeBlanc & Janssen, 2010) and perceptions of children's own activity levels (Greca et al., 2016). However, no qualitative studies appear to have discussed children's self-perceptions of physical activity. Children may perceive their physical activity levels accurately during interviews, as we found. In terms of motor competence, children responded accurately that they needed to improve their motor skills on the questionnaire. However, during interviews, children overestimated these skills. Lalor et al. (2016) and Estevan et al. (2018) noted that both parents and classroom teachers can better report children's motor competence than children can report themselves. The question to which children responded in this study included a simple "yes or no" response; thus, our findings that children overestimated motor competence during interviews were supported by Lalor et al. (2016) and Estevan et al. (2018). We observed mixed agreement across data sources regarding parents' and children's engagement. For parents, prior sports participation did not predict physical activity levels or motor competence. For children, current sports team involvement was associated with motor competence but not physical activity.

Physical activity data, motor competence data, interviews, and the home environment assessment were also consistent. Parents and children identified benefits and barriers during interviews regardless of physical activity and motor competence data. This pattern aligns with parents and children having accurate knowledge and overall positive perceptions as evidenced by interviews.

As for COVID-19, this study provides novel insight into the pandemic's impacts on parents' and children's physical activity. Minimal research has examined the consequences of COVID-19 on physical activity. To date, experts have predicted negative trends and adverse effects on societal physical activity and other health outcomes (Hall et al., 2020; Peçanha et al., 2020). Preliminary findings indicated lower step counts worldwide in the first few months of the pandemic (Tison et al., 2002) and declines in physical activity in children in the United States (Tulchin-Francis et al., 2021). In our study, parents reported spending more hours per day with their children on weekdays during COVID-19 than before COVID-19, perhaps due to executive orders and stay-at-home orders enacted in March 2020. Workplaces and schools also transitioned online. Parents and children then began to spend more weekday hours at home, accompanied mainly by household members, as confirmed in interviews. The lack of reported differences in subjective physical activity during COVID-19 compared to before COVID-19 was especially intriguing. Parents and children rated their physical activity levels similarly, implying that COVID-19 may not have affected such activity. Yet self-report measures must be interpreted cautiously. These assessments require individuals to subjectively recall and evaluate their physical activity (Vanhees et al., 2005). Research has shown that adults (Celis-Morales et al., 2012; Skender et al., 2016) and children (LeBlanc & Janssen, 2010) inaccurately report and overestimate physical activity. Parents' physical activity was assessed with the Godin Leisure-Time Exercise Questionnaire, and children's physical activity was assessed with the PAQ-C. Both assessments were modified to ask about physical activity before COVID-19, potentially affecting these instruments' validity. Parents and children were also asked to recall their physical activity before COVID-19 (i.e., approximately four to six months prior to the pandemic, depending on their completed questionnaire). Parents and children may not have been able to recall their physical activity within that timeframe fully. A recent online parent-reported survey that also used self-report assessment, modified Godin Leisure-Time Exercise Questionnaire, found that children's physical activity levels were significantly less for MVPA and overall physical activity during COVID-19 compared to before COVID-19 (Tulchin-Francis et al., 2021). Tulchin-Francis et al.

(2021) findings are in line with predictions about declining physical activity during COVID-19. However, our findings on the questionnaire do not align with this study. Our non-significant findings may be attributed to the fact that we had parents and children self-report their physical activity. It is possible that parent's physical activity was not altered, and children had difficulty recalling their physical activity behaviors.

Overall, parents agreed that their children's physical activity levels were similar during and before COVID-19, although several parents' responses changed between these two questions. Twelve additional parents responded that their child was "fairly inactive" during COVID-19 versus before COVID-19. Twenty-seven parents responded that their child was "fairly active" before COVID-19, but only 17 parents reported the same during COVID-19. Slightly less than three-quarters (69%) of parents felt that their child had not been more active during COVID-19. Even so, this question was limited; it did not ask whether physical activity had stayed the same or declined during versus before COVID-19. Even so, the questionnaire findings implied that parents found COVID-19 to have negatively affected their children's physical activity. Nevertheless, the quantitative results revealed no significant differences in parents' and children's physical activity or in parents' perceptions of their children's physical activity during versus before COVID-19.

The questionnaire and interviews were incongruent: in interviews, parents and children provided many more details about how COVID-19 had influenced their physical activity. Participants' remarks were mostly negative; parents and children generally felt that their physical activity levels had fallen during the pandemic. Decreased physical activity mirrored scholars' anticipated pandemic-related declines in physical activity across the United States and the world (Hall et al., 2020; Peçanha et al., 2020; Tulchin-Francis et al., 2021).).

Chapter V Conclusions and Summary

This chapter provides a conclusion and summary of this dissertation study. The section begins with an overall summary. The three main research gaps outline subsequent sections that this dissertation study sought to address. Each research gap features a discussion of key findings, implications, and directions for future research. This chapter concludes with the development of the Scott-Andrews conceptual model, implications for developing family-based physical activity interventions, the future of online research, the strengths and limitations of this study, and a dissertation study summary. Please refer to Appendix A for the abstract *Feasibility and challenges of converting an in-person study to online during the COVID-19 pandemic* presented at the North American Society for Psychology of Sport and Physical Activity Conference in June 2021.

Study Need

Physical activity levels are low across the United States for children and adults (Troiano et al., 2008; Tucker et al., 2011). The COVID-19 pandemic likely exacerbated this problem (Hall et al., 2020; Peçanha et al., 2020). The consequences of physical inactivity are severe. An important contributing factor to physical activity is motor competence (Robinson et al., 2015a; Stodden et al., 2008). Motor competence is defined as proficiency in a range of gross motor skills, including movement behaviors required to participate in sports, games, and other context-specific activities (Robinson et al., 2015a). Research has documented positive associations between motor competence and physical activity in children (Holfelder & Schott, 2014; Logan et al., 2015; Lubans et al., 2010). Longitudinal studies have shown that this association tracks into adolescence (Barnett et al., 2009; Jaakkola et al., 2016; Lima et al., 2017; Venetsanou & Kambas, 2017). Presumably, the association between motor competence and physical activity tracks into adulthood, although little research has examined this assumption (Cantell et al., 2008; Sackett & Edwards, 2019). Few scholars have examined motor competence, especially FMS competence, in adults (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013).

When examining physical activity and motor competence, it is also important to examine perceived competence. Perceived competence is associated with motor competence and physical activity in children (Barnett et al., 2008; Khodaverdi et al., 2015; Robinson et al., 2015a) and adults (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019). Perceived competence serves as a mediator between motor competence and physical activity in children (Barnett et al., 2008, 2011; Khodaverdi et al., 2015). In adults, perceived competence is associated with motor competence and physical activity (Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019).

Over the past several decades, researchers and practitioners have focused on devising effective and supportive strategies to increase and maintain optimal physical activity levels in children and adults. Guided by the social ecological model and social cognitive theory (SCT), this study sought to understand physical activity and motor competence determinants and perceived competence in parent-child dyads. This work focused on parent-child dyads because parents and families significantly influence health behaviors (Davison et al., 2013; Mâsse et al., 2017) as all aspects of health (e.g., health socialization, disease prevention, recuperative care) are centered and accomplished in families (Hanson et al., 2019). Parents are recognized as having the greatest influence over young children's daily lives and are commonly referred to as "gatekeepers" of the home and family (Haddad et al., 2018).

To develop a comprehensive understanding of what drives parents and children to be physically active, it was also necessary to understand physical activity and motor competence beliefs. Parents generally possess accurate knowledge about physical activity and motor competence (Haddad et al., 2018; Jarvis et al., 2020; Sawyer et al., 2014; Scott-Andrews et al., in review) but inaccurately perceive their children's physical activity levels (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020). Findings are mixed regarding perceptions of motor competence: some research has shown that parents overestimate their children's motor abilities (Silvia et al., 2017; Zysset et al., 2018), whereas other studies have found that parents are fairly good predictors of their children's motor competence (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015). A limited number of qualitative studies have examined beliefs about physical activity (Bentley et al., 2012; Brown et al., 2015; Humbert et al., 2006; Kesten et al., 2015; Moore et al., 2010; A. Thompson et al., 2003; J. Thompson et al., 2010), and none have focused on motor competence. Understanding parents' and children's beliefs via quantitative and qualitative methods can inform evidence-based, tailored interventions to target physical activity and motor competence.

The purpose of this dissertation study was to (1) examine associations between physical activity, motor competence, and perceived competence in parents and children (Aim 1); (2) develop an understanding of the associations between physical activity, motor competence, and perceived competence in parent-child dyads (Aims 2 & 3); and (3) investigate beliefs about physical activity and motor competence (Aim 4). The four aims of this study addressed essential research gaps in motor development that led to key findings, implications, and recommendations for future research. Additionally, as this study was converted to an online study during the COVID-19 pandemic, novel findings emerged regarding the impact of and experiences with COVID-19 for parents and children.

Research Gap 1- Physical Activity, Motor Competence, and Perceived Competence

Four studies have examined parents' motor competence (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013). Only two examined the association between motor competence and physical activity (Cantell et al., 2008; Sackett & Edwards, 2019). One limitation of these two studies was self-reported physical activity (Cantell et al., 2008; Sackett & Edwards, 2019). Only Sackett and Edwards (2019) adopted a combination of process- and product-oriented measures. Using both types of measures is recommended to ensure a comprehensive measure of motor competence (Logan et al., 2017; Robinson et al., 2015a). This dissertation study addressed these research gaps as follows:

1. By assessing parents' physical activity using an objective measure, accelerometers.
2. By assessing parents' motor competence using process- and product-oriented measures.

Key Findings

1. Parents' motor competence was not significantly associated with parents' physical activity.
2. Children's motor competence was not significantly associated with children's physical activity.
3. Perceived competence was not a mediator between motor competence and physical activity for parents or children.
4. Athletic competence was weakly correlated with motor competence in parents and approaching significance in children.

Implications

These findings do not align with dominant models in motor development, indicating positive associations among physical activity, motor competence, and perceived competence (Hulteen et al., 2008; Robinson et al., 2015a; Stodden et al., 2008). These models are based on extensive research involving children and adolescents. We hypothesized that these associations would persist into adulthood but observed no association between physical activity, motor competence, and perceived competence for children or parents. Studies have revealed a significant and positive association of motor competence and physical activity in children (Holfelder & Schott, 2014; Logan et al., 2015; Lubans et al., 2010) and adolescents (Jaakkola et al., 2016; Lima et al., 2017; Venetsanou & Kambas, 2017), with perceived competence mediating this association (Barnett et al., 2008, 2011 Khodaverdi et al., 2015). Only a few studies have examined physical activity, motor competence, and perceived competence in adults (Cantell et al., 2008; Jiménez-Díaz et al., 2018; Sackett & Edwards, 2019; Stodden et al., 2009, 2013), and no association has been identified between these variables (Cantell et al., 2008; Sackett & Edwards, 2019). However, these studies were limited in their motor competence variables and self-reported physical activity assessment. Their findings thus cannot conclusively demonstrate the lack of an association between physical activity, motor competence, and perceived competence in adults (Cantell et al., 2008; Sackett & Edwards, 2019). Our findings coincide with the literature on adults; however, more research is needed to address the constraints of previous studies and this dissertation study—mainly because we did not identify an association between motor competence, physical activity, and perceived competence in children aged 8–11 years old, even though this link is well established in motor development. Our non-significant findings demonstrate that this study was likely hindered by its nature and limitations of the motor competence variable.

Future Research

1. Usage of a more comprehensive motor competence variable. Due to the online format, only four motor skills were included (catch, jump, kick, and throw) for a total of six motor skill measures.
2. Development of a reliable and valid fundamental motor skill assessment for adults.

3. Development of a reliable and valid fundamental motor skill and perceived competence assessment for online research.
4. Replication of this study in a controlled in-person environment using reliable and validated assessments administered by a trained researcher (i.e., the dissertation study as originally proposed).

Research Gap 2- Parent Determinants

Parents play a critical role in their children's health behaviors (Davison et al., 2013; Mâsse et al., 2017). Parents' physical activity is a key factor in children's physical activity (Garriguet et al., 2017; Hutchen & Lee, 2018; Rodrigues et al., 2018; Xu et al., 2015; Yao & Rhodes, 2015). However, only four studies have objectively examined the association between parents' and children's physical activity (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). No research has considered the association between parents' and children's motor competence. This study addressed these research gaps as follows:

1. Measured physical activity objectively using accelerometers with parents and children.
2. Examined the association between parents' motor competence and children's motor competence.

Key Findings

1. Parents' and children's moderate and moderate to vigorous physical activity (MVPA) were significantly associated.
2. Parents' and children's motor competence was significantly associated.
3. No significant association was found between parents' and children's perceived competence.
4. No significant association was found between parents' motor competence and children's physical activity.

Implications

This study was one of the first to explore the association between parents' and children's motor competence. Previous work has demonstrated that parents play a vital role in their children's health behaviors, including physical activity, yet no study had directly examined motor competence. Our study showed that parents' physical activity and motor competence behaviors were significantly associated with children's physical activity and motor competence behaviors. These findings are important in the field of motor development. Understanding parent determinants can support effective interventions targeting low levels of physical activity and improving motor competence. The findings of this study indicate that parents with higher levels of physical activity and motor competence will likely have children with higher levels of these variables.

Future Research

1. Usage of a more comprehensive motor competence variable. Due to the online format, only four motor skills were included (catch, jump, kick, and throw) for a total of six motor skill measures.
2. Include both parents to examine differences between mothers and fathers and effects on their children. Mothers constituted most of our sample (83.6%); it is therefore necessary to incorporate fathers (or both mothers and fathers) when possible.
3. Replication of this study in a controlled in-person environment using reliable and validated assessments administered by a trained researcher (i.e., the dissertation study as originally proposed).

Research Gap 3- Beliefs

Little research has explored beliefs about physical activity and motor competence. Quantitative analysis has shown that parents possess accurate knowledge about physical activity and motor competence (Jarvis et al., 2020; Sawyer et al., 2014; Scott-Andrews et al., in review). However, parents hold inaccurate perceptions of their children's physical activity levels (Corder et al., 2010, 2012; Greca et al., 2016; Hesketh et al., 2013; Scott-Andrews et al., 2020). Findings regarding parents' perceptions of motor competence are mixed: some research has found that parents exhibit inaccurate perceptions (Silva et al., 2017; Zysset et al., 2018), whereas other studies suggest that parents are good predictors of their children's motor competence (Estevan et al., 2018; Lalor et al., 2016; Liong et al., 2015). Few qualitative studies exist in the physical activity literature overall, and none focus on motor competence. Qualitative work has indicated that parents have accurate knowledge (Thompson et al., 2010) but inaccurate perceptions; further, parents generally classify their children as fairly active (Bentley et al., 2012; Kesten et al., 2015). Other qualitative studies have revealed that various determinants influence physical activity engagement in parents and children (Brown et al., 2015; Humbert et al., 2006; Moore et al., 2010; Thompson et al., 2003). Taken together, more research is needed to clarify overall beliefs about physical activity and motor competence. This study addressed these research gaps as follows:

1. Examined beliefs about physical activity and motor competence through semi-structured interviews.
2. Examined beliefs about physical activity and motor competence using mixed methods, triangulating quantitative and qualitative data sources.

Key Findings

1. Seven themes were derived from interviews: knowledge, perceptions, engagement, benefits, barriers, motivators, and COVID-19.
2. Interviews indicated that parents had accurate knowledge about physical activity and motor skills. Children believed that physical activity was similar to exercise; they could not define motor skills.

3. Based on interviews, parents and children held positive perceptions about physical activity and motor competence. They believed physical activity and motor competence were fun when they were participating in activities they enjoyed. Also, physical activity was perceived as an important aspect of one's routine.
4. Interviews showed that, in most cases, parents and children often engaged in physical activity.
5. Based on interviews, parents and children identified an array of benefits, barriers, and motivators related to physical activity. Benefits pertained to health, well-being, and being able to engage in physical activity with others. Barriers included time, weather, and motivation. For parents, motivators revolved around doing physical activity for their children, while children's motivators entailed the social aspects of engaging with friends and siblings.
6. Parents and children discussed the effects of COVID-19 on their physical activity and motor competence during interviews. Every parent and child had unique experiences in terms of work and school status and physical activity. Generally, COVID-19 adversely affected physical activity due to restrictions put in place across Michigan.
7. Upon triangulating all data sources, parents appeared to possess accurate knowledge about physical activity and motor skills.
8. Data triangulation unveiled that parents held inaccurate perceptions about their children's physical activity and motor competence levels. Children overestimated their physical activity on questionnaires but accurately described their physical activity levels during interviews. Children responded accurately on questionnaires about their motor competence but overestimated such competence during interviews.

9. Based on the triangulation of all data sources, parents' prior engagement in organized activities was not associated with current physical activity or motor competence. For children, sports team participation was associated with motor competence but not physical activity.
10. Data triangulation showed that parents reportedly spent more hours with their children on weekdays during the pandemic. No difference manifested between self-reported physical activity during and before COVID-19, but interviews pointed to a negative impact on physical activity levels due to the pandemic.

Implications

This study was one of the first to adopt a mixed methods approach to understand parent-child beliefs about physical activity and motor competence. Understanding parents' and children's beliefs—especially their knowledge about, perceptions of, and engagement in physical activity and motor competence—can promote the development of effective, efficient, tailored interventions. The study also offers meaningful implications for motor development. It further reinforces the importance of ensuring that participants possess the requisite knowledge and accurate perceptions to support engagement in physical activity and develop motor competence. Physical activity enjoyment is essential to the development of physical activity interventions and aligns with research by Barnett et al. (2019). Additionally, this study provides novel insight about the COVID-19 pandemic: we found that parents and children had distinct experiences with COVID-19 but that the pandemic negatively influenced parents' and children's physical activity and motor competence. Disruptions to everyday life caused by COVID-19 rendered physical activity and motor competence extremely challenging.

Future Research

1. Conduct interviews with the whole family in the home, including the other parent and siblings, to develop a clearer understanding of family beliefs and the impact of the home environment.
2. Interview families and directly ask them what can support their physical activity and development of motor competence.

Conceptual Models and Theory

The design and development of this dissertation study was guided by the conceptual models developed by Stodden et al. (2008) and Robinson et al. (2015) as discussed in the introduction (see Figure I.1; I.2). These models propose a bidirectional association between motor competence and physical activity, mediated by perceived competence, health-related fitness, and obesity in children and adolescents (Robinson et al., 2015; Stodden et al., 2008). This study examined the associations between physical activity, motor competence, and perceived competence in parents and in children. This study proposed an updated model that incorporated adults, examined associations between parent-child dyads, and beliefs about physical activity and motor competence (see Figure I.3). However, the findings of this study do not support the Stodden et al. (2008) and Robinson et al. (2015) models, thus the proposed model from the introduction was updated accordingly (see Figure V.1). This study found that in parents and children, motor competence and physical activity were not associated indicated by the red X on Figure V.1. Thus, perceived competence could not be examined as a mediator. The domain of athletic competence within perceived competence was significantly associated with motor competence in parents and was trending towards significance in children indicated by the green arrow. While, athletic competence was not associated with physical activity, indicated by the red X. This study also found positive and significant parent-child associations and information about beliefs, indicated in green text on Figure V.1.

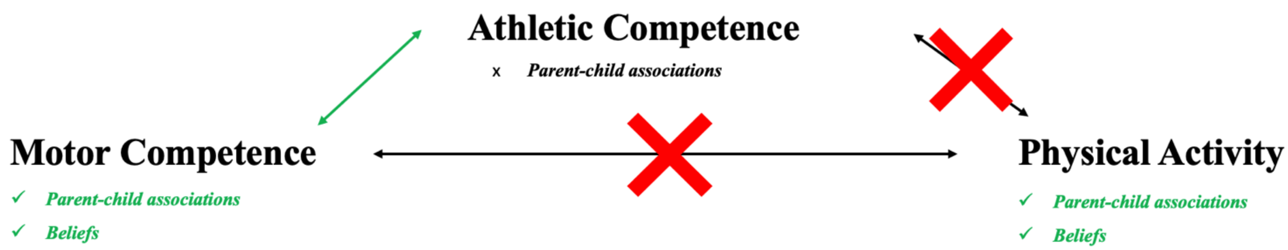


Figure V.1. Findings of the associations of parents and children applied to proposed conceptual model.

The Stodden et al. (2008) and Robinson et al. (2015) models have been extensively researched in both children and adolescents. The association between motor competence and physical activity in children and adolescents has been well established across numerous countries (e.g., United States, Australia, Canada, Germany, etc.), diverse participant demographics, and varying motor competence and physical activity levels (Barnett et al., 2008; Holfelder & Schott, 2014; Jaakkola et al., 2016; Lima et al., 2017; Logan et al., 2015; Lubans et al., 2010; Venetsanou & Kambas, 2017). Thus, it is likely that in this study, the non-significant association between motor competence and physical activity found in children can be attributed to the limited motor competence variable. In adults, the non-significant association may be attributed to the limited competence variable as well, or it may be that there is no significant association between motor competence and physical activity as found by Cantell et al. (2008) and Sackett & Edwards (2019). The latter explanation may be true, especially for the population included in this study and in Cantell et al. (2008) and Sackett & Edwards (2019). This study's participants self-selected and were majority white, highly educated, and affluent. In Cantell et al. (2008), participants also self-selected to participate and were recruited through Alberta Children's Hospital and University of

Calgary in Canada. No other demographic information was reported (Cantell et al., 2008). For the study conducted by Sackett & Edwards (2019), participants were 648 college-aged students, 82.6% white. Due to limitations by both the motor competence variable and sample characteristics, more research is needed to further examine the association between motor competence and physical activity in adults.

Even though the findings did not align with the conceptual models of Stodden et al. (2008) and Robinson et al. (2015a), there were other important findings in regard to parent-child associations and beliefs. This study found that: 1) parents and children's physical activity and motor competence are significantly and positively associated 2) parent's and children's beliefs about physical activity and motor competence impact their behaviors. These findings are situated with the social ecological model and align with SCT that guided the development of this dissertation study.

Scott-Andrews Conceptual Framework

This dissertation was grounded within the social ecological model, focusing on interpersonal and intrapersonal determinants that affect both parents' and children's physical activity and motor competence using SCT. SCT is based on reciprocal determinism of behavioral factors, personal factors, and environmental factors that collectively interact to influence parents' and children to engage or not engage in motor competence and physical activity (Hayden, 2014). Based on the findings of this study, the proposed SCT theory applied to this study in the introduction (see Figure I.4) was updated. This study found reciprocal determinism between physical activity and motor competence behaviors, environmental factors, and personal factors. The Scott-Andrews Conceptual Framework (see Figure V.2) was developed based on the premise of SCT and findings from this study. The Scott-Andrews Conceptual Framework explains determinants on parents' and children's physical activity and motor competence, expanding the work of Stodden et al. (2008) and Robinson et al. (2015) by incorporating other determinants on physical activity and motor competence. The bidirectional arrows in the Scott-Andrews Conceptual Framework signify the reciprocal determinism between all determinants. The Scott-Andrews Conceptual Framework will be used when referencing varying environmental and personal determinants on both children's and parent's physical activity levels and motor competence (i.e., behavioral factors). For children, environmental determinants include their parents' physical activity and motor competence levels, engagement, and motivators. Parents' environmental determinants include their children's' physical activity and motor competence levels, engagement, and motivators. For children and parents, personal factors include knowledge, perceptions, benefits, and barriers. Perceived competence was intentionally left out of the Scott-Andrews Conceptual Framework as this construct was not thoroughly examined in this study.

Of particular note, that the Scott-Andrews Conceptual Framework needs to be examined in more diverse samples. Currently, the Scott-Andrews Conceptual Framework is limited by this study's participant characteristics. This study's sample was fairly homogenous, and children reported high connectedness to their parents, meaning that they were more likely very influenced by both their parents and families overall. Our results may only be applicable to this study's population. Research has shown that younger children are more highly influenced by their parents' health behaviors (Yao & Rhodes, 2015), which aligns with this study's positive associations found with a greater percentage of children 8 and 9 years old than compared to 10 and 11 years old. Also, children reported high connectedness to their parents in this study. Still, it is possible that for children that do not report high connectedness that their parents' behaviors may not be an important determinant. Other determinants may be more important in influencing children who are disconnected from their parents and/or families; such as peers or other influential people in their lives.

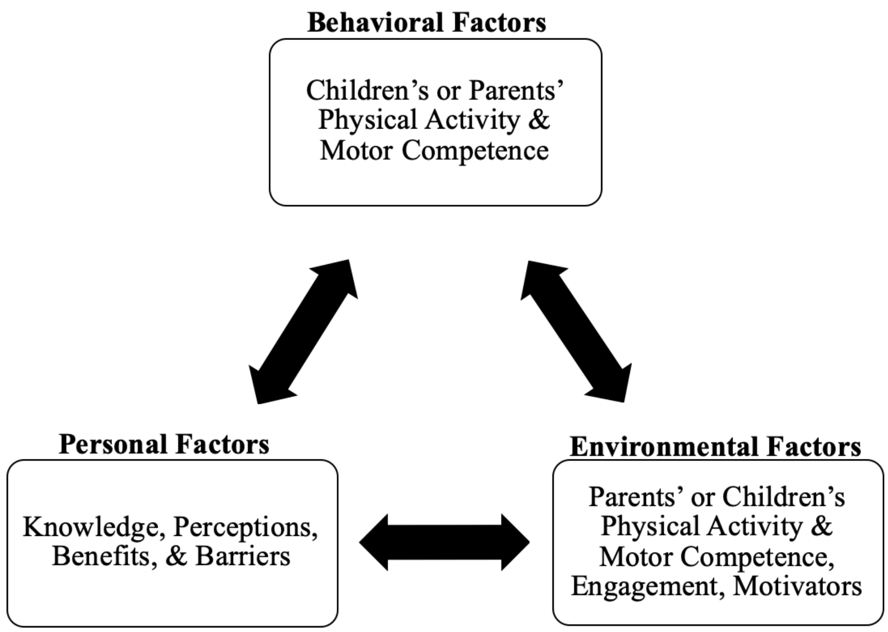


Figure V.2. Scott-Andrews Conceptual Framework for determiannts on parents' and children's physical activity and motor competence.

Developing Family-Based Interventions

Family-based physical activity programs provide an effective and promising approach to target low levels of physical activity in children and parents. Recent work has seen an increase in family-based physical activity intervention research as an approach to target physical inactivity in children (Brown et al., 2016) and family involvement is recognized as a best practice for physical activity interventions with children (Horodyska et al., 2015). Despite the recent emphasis on families and the demonstrated importance of integrating families in research and intervention efforts (Foster et al., 2018), family-based physical activity research and interventions remain an emerging field. A main body of research has focused on parents engagement as essential in family-based interventions to target obesity (Mehdizadeh et al., 2020; Schmied et al., 2018). Even so, the components that make up an effective family-based intervention are unknown, and heterogeneity among research and interventions makes it highly challenging to truly determine overall effectiveness (Brown et al., 2016). The findings of this dissertation study support development of feasible and effective family-based physical activity interventions. This study's findings highlight that parents are a significant influence on their children and incorporating the whole family in the intervention adds the bonus of targeting all members of the family's physical activity. Additionally, this study developed a better understanding of beliefs about physical activity and motor competence.

Considering the best approach for developing a physical activity intervention, it is essential to incorporate the family and speak directly with them. Families need to be empowered to be in control of their health. This study demonstrated that parents and children care about and understand the importance of physical activity and developing motor competence. Parents demonstrated that they are knowledgeable about physical activity and motor competence. Also, parents and children had positive perceptions, understood the benefits, and discussed engaging in physical activity. Based on the findings of this study, a physical activity intervention should incorporate the whole family, other families to provide social interaction, and include activities that are perceived as fun and enjoyable. Incorporating these key components addresses the main benefits, barriers, and motivators that parents and children discussed in this study. Also, in development, it is necessary to discuss with the families what they want in a family-based physical activity intervention, as they are the primary stakeholders. This study highlights that we can support parents and children to be active and develop motor competence. Still, we need to listen to their beliefs to support the development of positive health behaviors.

Lastly, it is inherently difficult to understand why parents and children are inactive in developing any intervention and find effective ways to promote physical activity (Ries et al., 2016). However, given the complexity of physical activity, this study highlights the importance of parent determinants on children's physical activity and motor competence. Results also offer additional insight into parents' and children's beliefs about physical activity and motor competence, including supporting parent-child dyads in encouraging physical activity and motor competence development.

The Future of Online Research

This study demonstrated that conducting online human subject research assessing physical activity, motor competence, and perceived competence is feasible. Due to the COVID-19 pandemic, U.S. society has become accustomed to an online world. Nearly every aspect of life occurred online or remotely—from work, school, research, doctor visits, and food delivery to social events. As the United States and the world gradually emerge from the pandemic's depth, society will forever be altered, and many tasks will continue to be conducted online due to ease and accessibility. When feasible, we believe research will include some online or remote component. This study demonstrated that such an arrangement is possible. Conducting research online offers many advantages, although numerous challenges should be addressed in future studies. The main obstacles in this study involved recruitment, technological issues, and the motor competence and perceived competence methodology.

The recruitment methods employed in this study were intended to reach all eligible participants. Multiple online platforms were used for recruitment to ensure a broad reach across the state of Michigan. However, as seen in Figure IV.1, parent-child dyads' geographic locations were centralized to southeastern Michigan. A few parent-child dyads were from southwestern Michigan, and no parent-child dyads from northern Michigan participated. Also, the sample was mostly White, educated, and middle to high socio-economic status: parents were 88.5% White and children were 75.4% White; 52.5% of parents held a graduate degree or higher; and 46% earned an annual household income of $100,000 or higher. Although these limitations are considerable, this study was an exploratory study conducted online. Thus, conducting an initial study with this population demonstrates the promise of this work. Future research should undoubtedly incorporate more diverse populations. As another recruitment obstacle, 200 families expressed interest in participating; of them, 76 parent-child dyads (approximately 38% of those interested) consented and assented, and only 61 completed at least one component of this study (20% attrition). "Expressing interest" was defined as either emailing the research team or clicking on "Interested in Participation" on Michigan Research Registry. After contacting interested respondents multiple times and through various methods, we could not convince a more significant number of individuals to consent and assent to participate. A lack of study participation or consenting was partially attributed to technological issues.

This study leveraged numerous online services and platforms, including the following: email; Box (Box, Redwood City, CA); Dropbox (Dropbox, San Francisco, CA); Qualtrics (Qualtrics, Provo, Utah); and Zoom (Zoom, San Jose, CA). The Humans Subjects Review Board approved the use of all platforms. Emails were used for communication purposes. We used Box and Dropbox to securely transmit and store consent and assent forms, motor skills videos, and interview transcripts. Some parents faced difficulty using these platforms due to being required to first create an account and then download, upload, and share files. The applications were more challenging to use on mobile devices or tablets versus computers; however, Box and Dropbox were continuously being updated over the course of this study and became more intuitive to use as the study progressed. The usage barriers associated with these platforms may have prevented participants from consenting and assenting to the study or from completing the motor competence component. Parents generally did not have trouble using Qualtrics or Zoom.

The last major hurdle in conducting this study, which examined physical activity, motor competence, and perceived competence, was the lack of online motor competence and perceived competence assessments. Thus, the author and two experts in kinesiology collaborated to create a motor competence assessment based on validated assessments and that the research team believed would be feasible for parents and children to complete at home. The motor skill videos that parents and children filmed were occasionally problematic: participants did not always follow directions, and some videos were of poor quality. These conditions complicated video coding. A few parents and children did not have motor competence scores because their motor skill videos were not codable. Also, the perceived competence assessment was transferred into an online format, which is not a reliable medium for this assessment. The assessment formant was not suited to administration through Qualtrics, hence why not all parents and children completed this questionnaire section correctly.

In sum, this study demonstrated that online methods are feasible for subsequent physical activity, motor competence, and perceived competence research. Future studies should address the challenges the study author encountered, specifically focusing on recruitment, technological issues, and online assessment administration. Overall, however, the ease and accessibility of online research presents many possibilities for motor development research.

Strengths and Limitations

Generalizability

It is important to address the limitations of generalizing this study. The recruitment methods employed were conducted to reach all eligible parent-child dyads in Michigan. Using multiple online platforms for recruitment was done intentionally. However, our sample was homogenous and not representative of the U.S. Census demographic data for the state of Michigan (USA Census Bureau, 2019). The study's sample influenced the findings and outcome of this study; thus, we will further discuss the sample characteristics and implications.

The demographics of the sample were majority white (i.e., 88% parents, 75.4% children), highly educated (i.e., 52.5% graduate degree or higher), affluent (i.e., 46% household income greater than or equal to $100,000) and centralized to the southeastern region of Michigan.

Additionally, other characteristics that may have influenced the findings of this study were that 83.6% of parents identified as mothers, 63.9% of children were aged 8 and 9 years old, and overall parents and children were highly active. The mean of parents MVPA 50.55 minutes per day and the mean of children's MVPA was 47.48 minutes per day. The purposeful sampling resulted in a sample of white, educated, affluent, all mothers, and considered relatively active as participants were selected to represent the quantitative data best.

Research has shown that physical activity varies across different demographics. In children, physical activity levels have been found to differ significantly by race/ethnicity, age, gender, and weight status (Belcher et al., 2010; Troiano et al., 2008). Adults' physical activity levels differ by sex, age, race/ethnicity, education level, marital status, geographical location, poverty level, and body mass index (BMI) (Carlson et al., 2015; Tucker et al., 2011). Physical activity levels have been found to be higher among males, non-Hispanic whites, adults with higher income, and education levels (Carlson et al., 2015). This study's sample characteristics mirrors these findings as our sample was active. In interpreting the results of this study, it is important to understand how determinants and experiences may vary by physical activity levels and how this sample may not be generalizable to other ethnicities/races, socioeconomic statuses, and geographical locations due to high activity physical activity levels.

The study's sample was majority mothers. There is limited research examining the influence of both parent's physical activity on their children's, but it is likely that mothers and father's influence their children's physical activity in different ways (Fuemmeler et al., 2011; Neshteruk et al., 2017; Yao & Rhodes, 2015). The problem is that only one parent is included in parent determinant studies, and mothers are more likely to be the participants (Hutchens & Lee, 2018; Neshteruk et al., 2017; Yao & Rhodes, 2015), which was found in this study as well. Fuemmeler et al. (2011) found trends that mothers' MVPA was correlated with daughters', and fathers' was correlated with sons', however, future research needs to examine this further. Neshteruk and colleagues (2017) reviewed the literature to examine fathers' influence on children's physical activity and examined ten studies. This review found that father's influenced girls' and boys' physical activity the same. Still, only ten studies included and heterogeneity among methods makes it difficult to draw conclusive statements (Neshteruk, et al., 2017). Yao & Rhodes (2015) found gender of the parent moderated the relationship between boy's physical activity and parents' physical activity. Father-son physical activity was significantly higher (r= .29) than mother-son physical activity (r= .19). However, this moderation effect was not found for girls (Yao & Rhodes, 2015). In our study, we had majority mothers and for children 59% were girls. It is possible that the gender of the parents and children influenced the findings of the present study. The implications of this is that this study's findings may be only generalizable to mothers, and may not be applicable to determinants of fathers physical activity and motor competence behaviors.

The study's sample had a higher percentage of younger children (aged 8 and 9 years) compared to older children (aged 10 and 11 years). Research has shown that parents have more influence over younger children, and the children that participated in this study were younger. All four studies that have objectively examined the association between parents' and children's physical activity have been conducted in young children aged (4-11 years) (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). Additionally, in the systematic review conducted by Yao & Rhodes (2015) of the 35 studies that examined parental modeling a stronger association between parents and children's physical activity was found in children aged 5.5–12.4 years with an association of r= .17 while children aged 12.5–19 years had an association of r= .08 (Yao & Rhodes, 2015). This previous research demonstrates that parents have more influence over younger children. If this sample included more children aged 10 and 11-year old, the association found in the present study may have been weaker or non-significant. On another note, the children in this study also responded that they were very connected to their parents. On the questionnaires, 88.1% of children responded that they strongly agree or agree that they are close to their parents, 96.6% of children reported that they strongly agree or agree that their parents care about them, and 93.2% of children reported strongly agree or agree that they have an excellent relationship to parents. It is probable that children who report not being as connected to their parents and/or family would not be as significantly influenced, and other determinants would be more influentical in supporting physical activity and motor competence. The significant associations found between parents' and children's physical activity and motor competence may be partially explained by both age of the children and connectedness.

This study's sample is comparable to the previous four studies that have objectively assessed parents' and children's physical activity (Fuemmeler et al., 2011; Jago et al., 2014; Moore et al., 1991; Ruiz et al., 2011). As discussed in the results, this study's findings align with Fuemmeler et al. (2011) conducted in the Southeastern United States and had a similar sample size, similar age range, and demographics. The sample examined in Fuemmeler et al. (2011) (N= 45 mothers and fathers) was majority white, highly educated, and fairly active. The present study and Fuemmeler et al. (2011) demonstrate limited generalizability to other populations and demographics. However, it is important to discuss the other studies that have examined physical activity objectively in children. Jago et al. (2014) conducted a wide-scale study (N= 1077) conducted in the United Kingdom found that parents' MVPA was weakly associated with children's MVPA. This study did not report participants' demographics but recruited from 57 different schools across the United Kingdom, which we can infer had a wider reach to a more diverse sample. Ruiz et al. (2011) examined associations between Hispanic parents (N= 80) and their preschool-aged child. Participants were Hispanic with majority country of region United States with only 7% holding a college diploma (Ruiz et al., 2011). Lastly, Moore et al. (1991) did not report race or ethnicity, but education levels varied. Taken together, these findings demonstrate that the significant association found between parents' and children's physical activity and motor competence may be partially attributed to this study's sample characteristics. Different characteristics of parents probably influence their children differently. A sample that is not majority white, highly educated, and affluent may not have significant associations between parent-child dyads. Future research should examine parent determinants in varying populations to further understand the influence of the home environment.

This was an exploratory study of online research in motor development conducted during the COVID-19 pandemic. This research with this population demonstrates online research in motor development is feasible. The participant characteristics of this study may have directly influenced the findings of this study, especially regarding demographics, majority mothers, children's age, and children's connectedness; future work must examine the associations and beliefs of physical activity and motor competence in parents and children in different populations. Different factors are probably more important in different populations.

Strengths

1. Far-reaching recruitment methods were adopted. Parents and children were recruited via numerous online platforms, including the Child, Movement, Activity, and Developmental Health (CMAH) Laboratory; the Childhood Disparities Research Laboratory (CDRL); the University of Michigan research studies registry; emails sent to public listservs; and through social media posts on the author's personal account, the CMAH lab account, and CDRL account.
2. The online format allowed for flexibility when parents and children completed research tasks and eased participants' burden from attending in-person assessments.

3. The online methodology allowed for this study to be conducted during the COVID-19 pandemic, when most human subject research had been halted. Novel insights were drawn from the pandemic's impact on parent-child dyads' physical activity and motor competence.
4. This study was grounded in established motor development conceptual models, namely those by Robinson et al. (2015a) and Stodden et al. (2008), to evaluate the association of physical activity, motor competence, and perceived competence. Additionally, the social ecological model and SCT guided an understanding of parent determinants and beliefs about motor competence and physical activity.
5. Following best practice, the motor competence variable included both process and product measurements to more comprehensively assess this concept.
6. Physical activity was evaluated using accelerometers over a 7-day wear period.

Limitations

1. This study utilized motor competence and perceived competence assessments that were not developed for online administration.
2. This study evaluated parents' motor competence using an unvalidated motor skill assessment, as no validated fundamental motor skill assessment is currently available for adults.
3. The online format led to only four motor skills being assessed, thus limiting the motor competence variable to six measurements. These four skills were chosen because parents and children could perform them without a researcher present.
4. COVID-19 guidelines and procedures for workplaces and schools may have influenced participants' study participation in addition to altering their physical activity levels and/or motor competence. The sample was mostly White, educated, affluent, and fairly active. As

noted, parents and children were 88.5% and 75.4% white, respectively; parents were highly educated (52.5% had a graduate degree or higher); parents' annual household income was substantial (46% earned $100,000 and above); the mean of parents MVPA was 50.55 minutes per day and the mean of children's MVPA was 47.48 minutes per day.

5. This research did not examine factors of health-related fitness on physical activity and motor competence.

Dissertation Study Summary

This study sought to examine the association between physical activity, motor competence, and perceived competence in parents and children; to explore the association between parents' and children's physical activity, motor competence, and perceived competence; and to investigate beliefs about physical activity and motor competence. Additionally, this study examined the impact of the COVID-19 pandemic on physical activity and motor competence. This work provided novel insight into the association between parents' and children's physical activity and motor competence. Also, interviews with parents and children underlined the importance of discussing beliefs about physical activity and motor competence. Lastly, the negative impacts of COVID-19 further demonstrate the need for more evidence-based and tailored interventions to support health-enhancing behaviors as U.S. society emerges from the pandemic.

Appendices

Appendix A North American Society for Psychology of Sport and Physical Activity 2021 Abstract

Feasibility and challenges of converting an in-person study to virtual during the COVID-19 pandemic

Katherine Q. Scott-Andrews, Alison Miller, Rebecca Hasson, Thomas Templin, and Leah E. Robinson, University of Michigan

Due to the global pandemic of COVID-19 and Executive Orders instituted across the United States, the way we live, learn, and conduct research has been significantly altered. The need to pivot to virtual research was essential and instantaneous. We will discuss the feasibility and challenges of converting an in-person study that examined motor competence (MC), physical activity (PA), and perceived motor competence (PMC) to a virtual format with parent-child dyads. Recruitment was conducted through the university research registry, social media, and public listservs. All correspondence with participants were conducted through email and secure platforms. PMC was assessed with the Self-Perception Profile for Adults and Children. MC was assessed through participants filmed trials for kick, throw, jump, and catch along with jump distance and catch percentage, to obtain process (Test of Gross Motor Development-3) and product measures, respectively. PA was assessed with Actigraph (Pensacola, FL, USA) accelerometers mailed to participants with wear instructions. Approximately 200 families expressed interest in the study and 76 parent-child dyads (38%) consented and assented. Of these, 15 dyads dropped out (20%) due

to lack of response, time, and health issues. It is feasible to conduct virtual research. However, several challenges arose that range from response rates, motor skill measurement, and technological issues. A virtual format may have impeded participants due to access to internet and technology. Future research will need to address these challenges by developing methods that address virtual recruitment, establish validity and reliability for virtual PMC and MC assessments, and ease participants burden with technology. The way we conduct research has changed due to COVID-19 and adapting to virtual methods is both necessary and feasible but modifications must be taken into consideration.

Funding: Rackham Graduate Student Research Grant, University of Michigan

Appendix B Phase II Forms

Parent Questionnaire
About You and Your Child

CHILD MOVEMENT, ACTIVITY, &
DEVELOPMENTAL HEALTH LAB

To start:

1. Did you help your child complete their portion of the questionnaire?
   a. Yes
   b. No

PART 1: About You and Your Child (Demographics)

1. What is the gender of your child?

   a. Female b. Male c. Prefer not to answer

2. What is your child's approximate height and weight? (we need this information for the accelerometer) ___________

3. What is your child's ethnicity?

   a. White
   b. Hispanic or Latino
   c. Black or African American
   d. Native American Indian
   e. Asian
   f. Native Hawaiian or Other Pacific Islander
   g. Other (please specify): _______________

4. On average how many hours a day do you spend with your child before COVID-19?

   a. On weekdays ____________hours

   b. On weekends ____________hours

5. On average how many hours a day do you spend with your child currently?

   a. On weekdays ____________hours

   b. On weekends ____________hours

6. What is your relationship to your child?

   a. Mother
   b Father

c. Grandmother
d. Grandfather
d. Legal Guardian
e. Other (please specify): _______________

9. How old are you?

a. ≤ 20 years
b. 20-29 years
c. 30-39 years
d. 40-49 years
e. 50-59 years
f. 60-69 years
g. ≥ 70 years

10. What is your approximate height and weight? (we need this information for the accelerometer)

____

11. What is your ethnicity?

a. White
b. Hispanic or Latino
c. Black or African American
d. Native American Indian
e. Asian
f. Native Hawaiian or Other Pacific Islander
g. Other (please specify): _______________

12. How many children (ages 0-18) live in your household?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

13. How many adults (ages 18+) live in your household? (including yourself)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

14. What is your total household income?

a. Less than $24,999
b. $25,000 to $49,999
c. $50,000 to $99,999
d. $100,000 to $149,999
e. More than $150,000

15. What is your highest level of education?

a. Less than high school degree
b. High school degree or equivalent (e.g., GED)
c. Some college but no degree
d. Associate degree
e. Bachelor degree
f. Graduate degree

g. Other (please specify):___________________

16. What is your current occupation/ profession? _________________

17. Are you currently employed? __________________

18. Are you currently working in or out of the home? _______________

19. What type of home are you living in?
    a. Single family home
    b. Townhome
    c. Apartment
    d. Other: ______

20. Do you have a specific indoor space for physical activity (i.e., gym, exercise room, play space)?
    a. Yes
    b. No

21. Do you have an independent outdoor space?
    a. Balcony
    b. Small yard or garden
    c. Large yard or garden
    d. We do not have an independent outdoor space

<u>Part 2: Current Stress</u>

Perceived Stress Scale

1. In the last month, how often have you felt you were unable to control the important things in your life?

a. Never b. Almost never c. Sometimes d. Fairly often e. Very often

2. In the last month, how often have you felt confident about your ability to handle your personal problems?

a. Never b. Almost never c. Sometimes d. Fairly often e. Very often

3. In the last month, how often have you felt that things were going your way?

a. Never b. Almost never c. Sometimes d. Fairly often e. Very often

4. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

a. Never b. Almost never c. Sometimes d. Fairly often e. Very often

COVID-19 Stress Questions

The current coronavirus (COVID-19) outbreak is causing extra stress for many people, including families with children of all ages. We would like to know how things are going for you and your family related to this situation. Please answer the following questions about your experiences and feelings since the start of COVID-19 related events and changes, using the following scale.

***Select "strongly disagree" if you feel you have "No Stress" about an item.**

5. Food running out or being unavailable

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

6. Losing a job or decrease in family income

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

7. Housing or utilities

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

8. Loss of or limited childcare

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

9. Taking care of children, including those who are normally in school

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

10. Tension or conflict between household members

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

11. Physical health concerns for me or a family member

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

12. Increased anxiety or depression

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

13. Reminders of past stressful/traumatic events

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

14. Loss of social connections, social isolation

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

15. Access to medical care or prescriptions for me or a family member

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

16. Access to mental health care

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

17. Working in a high-risk environment as an “essential” worker (e.g., healthcare, grocery store, sanitation, delivery person, etc.)

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

18. My child(ren)’s behavior

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

18. Being treated disrespectfully based on my race

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

20. Being treated disrespectfully based on my income status

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

21. Being denied healthcare or service (retail, etc.) based on my race
a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

22. Wearing a mask or other coverings in public

a. Strongly disagree b. Somewhat disagree c. Neither agree or disagree d. Somewhat agree e. Strongly agree f. Not Applicable

Part 3: Confusion, Hubbub, and Order Scale (CHAOS)

1. There is very little commotion in our home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

2. We can usually find things when we need them.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

3. We almost always seem to be rushed.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

4. We are usually able to stay on top of things.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

5. No matter how hard we try, we always seem to be running late.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

6. It's a real zoo in our home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

7. At home we can talk to each other without being interrupted.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

8. There is often a fuss going on at our home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

9. No matter what our family plans, it usually doesn't seem to work out.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

10. You can't hear yourself think in our home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

11. I often get drawn into other people's arguments at home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

12. Our home is a good place to relax.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e. Definitely true

13. The telephone takes up a lot of our time at home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e.

Definitely true

14. The atmosphere in our home is calm.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e.

Definitely true

15. First thing in the day, we have a regular routine at home.

a. Definitely untrue b. Somewhat untrue c. Neither untrue nor true d. Somewhat true e.

Definitely true

PART 4: Physical Activity Behaviors (Godin et al., 2011)

Prior to COVID-19 affecting your lives:
1. During a typical **7-day period** (a week), how many times **did you** engage in the following activities for **more than 15 minutes**.

a. Strenuous Physical Activity (Heart Beats Rapidly) (e.g., running, jogging, hockey, football, soccer, basketball) ______________times per week

b. Moderate Physical Activity (Not Exhausting; Able to hold a conversation) (e.g., fast walking, baseball, tennis, bicycling, volleyball)
______________times per week

c. Mild/ Light Physical Activity (Minimal Effort) (e.g. yoga, archery, bowling, golf, slow walking)

______________times per week

2. During a typical **7-day period** (a week), how many times **did your child's** other parent engage in the following activities for **more than 15 minutes**.

a. Strenuous Physical Activity (Heart Beats Rapidly) (e.g., running, jogging, hockey, football, soccer, basketball) ______________times per week

b. Moderate Physical Activity (Not Exhausting; Able to hold a conversation) (e.g., fast walking, baseball, tennis, bicycling, volleyball)
______________times per week

c. Mild/ Light Physical Activity (Minimal Effort) (e.g. yoga, archery, bowling, golf, slow walking)

______________times per week

d. No Knowledge

Currently:
3. During a typical **7-day period** (a week), how many times **do you** engage in the following activities for **more than 15 minutes**.

a. Strenuous Physical Activity (Heart Beats Rapidly) (e.g., running, jogging, hockey, football, soccer, basketball) ______________times per week

b. Moderate Physical Activity (Not Exhausting; Able to hold a conversation) (e.g., fast walking, baseball, tennis, bicycling, volleyball)
______________times per week

c. Mild/ Light Physical Activity (Minimal Effort) (e.g. yoga, archery, bowling, golf, slow walking)

______________times per week

4. During a typical **7-day period** (a week), how many times **does your child's** other parent engage in the following activities for **more than 15 minutes**.

a. Strenuous Physical Activity (Heart Beats Rapidly) (e.g., running, jogging, hockey, football, soccer, basketball) ______________times per week

b. Moderate Physical Activity (Not Exhausting; Able to hold a conversation) (e.g., fast walking, baseball, tennis, bicycling, volleyball)
______________times per week

c. Mild/ Light Physical Activity (Minimal Effort) (e.g. yoga, archery, bowling, golf, slow walking)

______________times per week

d. No Knowledge

Past Physical Activity Behaviors:
5. How often did you participate in **vigorous (aerobic) physical activity or sports** at least twice per week (e.g., swimming, aerobics, soccer, basketball, biking, football, running)?

a. During high school:

a. Never (0 months) b. 1-3 months c. 4-6 months d. 7-9 months e.10-12 months

b. During ages 18-22 years:

a. Never (0 months) b. 1-3 months c. 4-6 months d. 7-9 months e.10-12 months

c. What type/s of physical activity or sports teams did you participate in high school?

____

d. What type/s of physical activity or sports teams did you participate in ages 18-22 years?

____

PART 5: Beliefs about Physical Activity and Motor Skills

1. Do you feel there is a difference between ***physical activity*** and ***motor skills***?

☐ Yes ☐ No

2. How would you define ***physical activity***?

____

3. How would you define ***motor skills***?

____

4. How physically active would you say your child is?

a. Very inactive
b. Fairly inactive
c. Neither inactive nor active
d. Fairly active
e. Very active

5. Do you think your child needs to be more physically active?

☐ Yes ☐ No

6. Does your child meet the physical activity guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity **every day** (i.e., aerobic activities such as running, jumping rope, skipping, biking)?

☐ Yes ☐ No

7. Since COVID-19, do you think you child has been obtaining more physical activity?

a. Yes
b. No

8. How would you describe your child's physical activity levels during COVID-19?

a. Very inactive
b. Fairly inactive
c. Neither inactive nor active
d. Fairly active
e. Very active

9. Do you think your child is proficient at motor skills?

a. Not very proficient
b. Not fairly proficient
c. Neither not proficient nor proficient
d. Fairly proficient
e. Very proficient

10. Do you think your child needs improvements in their motor skills?

☐ Yes ☐ No

11. Since COVID-19, have you worked on improving your child's motor skills?

a. Yes

b. No

11. How physically active would you categorize yourself?

a. Very inactive
b. Fairly inactive
c. Neither inactive nor active
d. Fairly active
e. Very active

12. How physically active would you categorize your child's other parent?

a. Very inactive
b. Fairly inactive
c. Neither inactive nor active
d. Fairly active
e. Very active
f. No knowledge

<u>PART 6: Self-Perception Profile</u>

What I Am Like?

The following statements that allow people to describe themselves. There are no right or wrong answers since people differ. Please read the entire sentence across. First, decide which one of the two parts of each statement best describes you; then go to that side of the statement and check whether that is just sort of true for you or really true for you. You will check **ONE** of the four boxes for each statement.

	Really True for me	**Sort of True for me**				**Sort of True for me**	**Really True for me**
1.	☐	☐	Some adults like the way they are leading their lives	**BUT**	Other adults don't like the way they are leading their lives	☐	☐
2.	☐	☐	In games and sports some adults usually watch instead of play	**BUT**	Other adults usually play rather than just watch	☐	☐
3.	☐	☐	Some adults are happy with the way they look	**BUT**	Other adults are not happy with the way they look	☐	☐
4.	☐	☐	Some adults are very happy being the way they are	**BUT**	Other adults would like to be different	☐	☐

5.	☐	☐	Some adults sometimes question whether they are a worthwhile person	**BUT**	Other adults feel that they are a worthwhile person	☐	☐
6.	☐	☐	Some adults think they could do well at just about any new physical activity they haven't tried before	**BUT**	Other adults are afraid they might not do well at physical activities they haven't tried	☐	☐
7.	☐	☐	Some adults think that they are not very attractive or good looking	**BUT**	Other adults think that they are attractive or good looking	☐	☐
8.	☐	☐	Some adults are disappointed with themselves	**BUT**	Other adults are quite pleased with themselves	☐	☐
9.	☐	☐	Some adults do not feel that they are very good when it comes to sports	**BUT**	Other adults feel that they do very well at all kinds of sports	☐	☐
10.	☐	☐	Some adults like their physical appearance the way it is	**BUT**	Other adults do not like their physical appearance	☐	☐
11.	☐	☐	Some adults are dissatisfied with themselves	**BUT**	Other adults are satisfied with themselves	☐	☐
12.	☐	☐	Some adults like the kind of person they are	**BUT**	Other adults would like to be someone else	☐	☐
13.	☐	☐	Some adults feel they are better than others their age at sports	**BUT**	Other adults don't feel they can play as well	☐	☐
14.	☐	☐	Some adults are unsatisfied with something about their face or hair	**BUT**	Other adults like their face and hair the way they are	☐	☐

Child Questionnaire
About You

CHILD MOVEMENT, ACTIVITY, &
DEVELOPMENTAL HEALTH LAB

PART 1: Parent and Family Connectedness

1. I feel very close to my parents.

    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

2. My parents really care about what happens to me.

    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

3. I have a good relationship with my parents.

    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

Additional information:

4. We want to learn a little more about your family.

    a. How many older brothers do you have? _______
    b. How many younger brothers do you have? _______
    c. How many older sisters do you have? _______
    d. How many younger sisters do you have? _______

5. Do these siblings [if applicable] play sports or do physical activities?
    a. Yes. What sports/ physical activities?
    ____
    b. No

PART 2: Physical Activity and Motor Skills

1. How physically active would you categorize yourself?

a. Very inactive
b. Fairly inactive
c. Neither inactive nor active
d. Fairly active
e. Very active

2. Do you meet the physical activity guidelines of obtaining 60 minutes a day of moderate to vigorous physical activity **every day** (i.e., aerobic activities such as running, jumping rope, skipping, biking)?

☐ Yes ☐ No

3. Do you think you need to be more physically active?

☐ Yes ☐ No

4. Do you feel motor skills are important (i.e., being able to move your muscles/body different ways for sports or games)? Example: running, skipping, throwing, kicking, catching, etc.

☐ Yes ☐ No

5. Do you think you need to improve your motor skills?

☐ Yes ☐ No

PART 3: Your Physical Activity Behavior

For the following questions think back to before COVID-19 affecting your lives.
Now we are trying to find out about your level of physical activity during a typical 7-days (i.e., a week) **before COVID-19**. This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

1. Physical activity in your spare time: Did you do any of the following activities in a typical week before COVID-19? If yes, how many times? (Mark only one circle per row).

	No	**1-2**	**3-4**	**5-6**	**7 times or more**
Skipping	☐	☐	☐	☐	☐
Rowing/canoeing	☐	☐	☐	☐	☐
In-line skating	☐	☐	☐	☐	☐
Tag	☐	☐	☐	☐	☐
Walking for exercise	☐	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐	☐
Jogging or running	☐	☐	☐	☐	☐

Aerobics	☐	☐	☐	☐	☐
Swimming	☐	☐	☐	☐	☐
Baseball or softball	☐	☐	☐	☐	☐
Dance	☐	☐	☐	☐	☐
Football	☐	☐	☐	☐	☐
Badminton	☐	☐	☐	☐	☐
Skateboarding	☐	☐	☐	☐	☐
Soccer	☐	☐	☐	☐	☐
Street hockey	☐	☐	☐	☐	☐
Volleyball	☐	☐	☐	☐	☐
Floor hockey	☐	☐	☐	☐	☐
Basketball	☐	☐	☐	☐	☐
Ice skating	☐	☐	☐	☐	☐
Cross-country skiing	☐	☐	☐	☐	☐
Ice hockey/ ringette	☐	☐	☐	☐	☐
Other: ____________________	☐	☐	☐	☐	☐

2. In a typical week before COVID-19, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one.)

None…………………………………………………... ☐

1 time during a typical week………………………………..…. ☐

2 or 3 times during a typical week…………………………..……. ☐

4 times during a typical week………………………..…….. ☐

5 times during a typical week……………………....……… ☐

3. In a typical week before COVID-19 how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one.)

None…………………………………………….... ☐

1 time during a typical week……………………………..…. ☐

2 or 3 times during a typical week…………………….……. ☐

4 times during a typical week………………………..…….. ☐

5 times during a typical week……………………....……… ☐

4. During a typical weekend before COVID-19, how many times did you do sports, dance, or play games in which you were very active? (Check one one.)

None…………………………………………….... ☐

1 time during a typical week……………………………..…. ☐

2 or 3 times during a typical week…………………….……. ☐

4 times during a typical week………………………..…….. ☐

5 times during a typical week……………………....……… ☐

5. Which of the following describes you best for a typical week before COVID-19? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve
little physical effort…………………………………………………….... ☐

B. I sometimes (1 – 2 times) did physical things in my free time

(e.g. played sports, went running, swimming, bike riding, did aerobics)……….. ☐

C. I often (3-4 times) did physical things in my free time……………. ☐

D. I quite often (5-6 times) did physical things in my free time………… ☐

E. I very often (7 or more times) did physical things in my free time…... ☐

6. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) during a typical week before COVID-19.

	None	Little bit	Medium	Often	Very often
Monday…………………	☐	☐	☐	☐	☐
Tuesday…………………	☐	☐	☐	☐	☐
Wednesday…………….. .	☐	☐	☐	☐	☐
Thursday…………………	☐	☐	☐	☐	☐

Friday……………………	☐	☐	☐	☐	☐
Saturday…………………	☐	☐	☐	☐	☐
Sunday…………………...	☐	☐	☐	☐	☐

Now you are going to complete the following questions for currently.

Now we are trying to find out about your level of physical activity from the last 7 days (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row).

	No	**1-2**	**3-4**	**5-6**	**7 times or more**
Skipping	☐	☐	☐	☐	☐
Rowing/canoeing	☐	☐	☐	☐	☐
In-line skating	☐	☐	☐	☐	☐
Tag	☐	☐	☐	☐	☐
Walking for exercise	☐	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐	☐
Jogging or running	☐	☐	☐	☐	☐
Aerobics	☐	☐	☐	☐	☐
Swimming	☐	☐	☐	☐	☐
Baseball or softball	☐	☐	☐	☐	☐
Dance	☐	☐	☐	☐	☐
Football	☐	☐	☐	☐	☐
Badminton	☐	☐	☐	☐	☐

Skateboarding	☐	☐	☐	☐	☐
Soccer	☐	☐	☐	☐	☐
Street hockey	☐	☐	☐	☐	☐
Volleyball	☐	☐	☐	☐	☐
Floor hockey	☐	☐	☐	☐	☐
Basketball	☐	☐	☐	☐	☐
Ice skating	☐	☐	☐	☐	☐
Cross-country skiing	☐	☐	☐	☐	☐
Ice hockey/ ringette	☐	☐	☐	☐	☐
Other: ____________________	☐	☐	☐	☐	☐

2. In the last 7 days, on how many days *during the day*, did you do sports, dance, or play games in which you were very active? (Check one one.)

None…………………………………………………... ☐

1 time last week………………………………..…. ☐

2 or 3 times last week…………………………..……. ☐

4 times last week…………………………...…….. ☐

5 times last week……………………….....……… ☐

3. In the last 7 days how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one one.)

None…………………………………………………... ☐

1 time last week………………………………..…. ☐

2 or 3 times last week…………………………..……. ☐

4 times last week…………………………...…….. ☐

5 times last week……………………….....……… ☐

4. On the last weekend, how many times did you do sports, dance, or play games in which you were very active? (Check one one.)

None…………………………………………………... ☐

1 time last week……………………………..…. ☐

2 or 3 times last week……………………….……. ☐

4 times last week…………………………..…….. ☐

5 times last week……………………….....……… ☐

5. Which of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort…………………………………………………………..... ☐

B. I sometimes (1 – 2 times last week) did physical things in my free time

(e.g. played sports, went running, swimming, bike riding, did aerobics)……….. ☐

C. I often (3-4 times last week) did physical things in my free time……………. ☐

D. I quite often (5-6 times last week) did physical things in my free time………… ☐

E. I very often (7 or more times last week) did physical things in my free time…... ☐

6. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday…………………	☐	☐	☐	☐	☐
Tuesday…………………	☐	☐	☐	☐	☐
Wednesday…………….. .	☐	☐	☐	☐	☐
Thursday…………………	☐	☐	☐	☐	☐
Friday…………………….	☐	☐	☐	☐	☐
Saturday………………….	☐	☐	☐	☐	☐
Sunday…………………...	☐	☐	☐	☐	☐

7. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes………………………………….. ☐

No………………………………….. ☐

PART 4: Self-Perception Profile

What I Am Like?

The following statements that allow people to describe themselves. There are no right or wrong answers since people differ. Please read the entire sentence across. First, decide which one of the two parts of each statement best describes you; then go to that side of the statement and check whether that is just sort of true for you or really true for you. You will check **ONE** of the four boxes for each statement.

	Really True for me	Sort of True for me				Sort of True for me	Really True For me
1.	☐	☐	Some kids do very *well* at all kinds of sports and activities	**BUT**	Other kids *don't* feel that they are very good when it comes to sports and activities	☐	☐
2.	☐	☐	Some kids *are* happy with the way they look	**BUT**	Other kids are *not* happy with the way they look	☐	☐
3.	☐	☐	Some kids are often unhappy with themselves	**BUT**	Other kids are pretty pleased with themselves	☐	☐
4.	☐	☐	Some kids wish they could be a lot better at sports and activities	**BUT**	Other kids feel they are good at sports and activities	☐	☐
5.	☐	☐	Some kids are *happy* with their height and weight	**BUT**	Other kids wish their height or weight were *different*	☐	☐
6.	☐	☐	Some kids don't like the way they are leading their life	**BUT**	Other kids do like the way they are leading their life	☐	☐
7.	☐	☐	Some kids think they could do well at just about any new sport activities they haven't tried before	**BUT**	Other kids are afraid they might *not* do well at sport activities they haven't ever tried	☐	☐
8.	☐	☐	Some kids wish their body was *different*	**BUT**	Other kids *like* their body the way it is	☐	☐
9.	☐	☐	Some kids are happy with themselves as a person	**BUT**	Other kids are often not happy with themselves	☐	☐
10.	☐	☐	Some kids feel that they are *better* than others their age at sports and activities	**BUT**	Other kids *don't* feel they can play as well	☐	☐

11.	☐	☐	Some kids wish their physical appearance (how they look) was *different*	**BUT**	Other kids *like* their physical appearance the way it is	☐	☐
12.	☐	☐	Some kids like the kind of person they are	**BUT**	Other kids often wish they were someone else	☐	☐
13.	☐	☐	In games and sports some kids usually *watch* instead of play	**BUT**	Other kids usually *play* rather than just watch	☐	☐
14.	☐	☐	Some kids wish something about their face or hair looked *different*	**BUT**	Other kids *like* their face and hair the way they are	☐	☐
15.	☐	☐	Some kids are very happy being the way they are	**BUT**	Other kids wish they were different	☐	☐
16.	☐	☐	Some kids *don't* do well at new outdoor games and activities	**BUT**	Other kids are *good* at new games and activities right away	☐	☐
17.	☐	☐	Some kids are not very happy with the way they do a lot of things	**BUT**	Other kids think the way they do things is fine	☐	☐

CHILD MOVEMENT, ACTIVITY, & DEVELOPMENTAL HEALTH LAB

Motor Skills Directions

You and your child will be filming each other throwing, kicking, catching and jumping. You will need 1 additional person to help film/ toss a ball for the catch. **This process will take approximately 30 minutes to complete and should be completed in the outdoors in an open space.**

Follow these step-by-step instructions:

1. First, gather up your equipment. You will need:
   - Smartphone, tablet, or other filming device.
   - A small ball/ object to throw and catch. Such as a tennis ball, nerf ball, or balled up socks.
   - A larger ball or equivalent to kick. Such as a medium size playground ball or size 4 soccer ball.
   - *Optional:* A measuring tape for the jump.
2. Tips for filming:
   - **Throw:** Try to get a sideways view of the entire person in the frame on the side they are doing the action. In other words, for a left-hand throw, film the left-hand side.
   - **Catch:** Try to get a straight on view of the entire person. Another person will need to toss the ball/object from approximately 9 feet away
   - **Kick:** Try to get a sideways view of the entire person in the frame on the side they are doing the action and include a *few steps prior to kicking the ball*. In other words, for a left footed kick, film on the left-hand side.
   - **Jump:** Try to get a sideways view of the entire person in the frame.
3. For the throw and kick skills you will both watch the corresponding video, **complete 1 practice trial**, and then both watch the video again. Next, you will film (or other family member) your child completing the skill for **2 trials**. Last your, child (or other family member) will film you complete the skill **2 trials**.
   - Throw video
   - Kick video
4. For the catch and jump skills you will both watch the corresponding video, **complete 1 practice trial**, and then both watch the video again. Next, you will film (or other family member) your child completing the skill for **5 trials**. Last your, child (or other family member) will film you complete the skill for **5 trials**.
   - Catch Video
   - Jump video
5. Once you have completed filming, we ask that you upload your videos to University of Michigan Box. You should have received an email inviting you to upload your files. There should be a total of 8 videos that you upload- child throwing 2 times, parent throwing 2 times, child kicking 2 times, parent kicking 2 times, child catching 5 times, parent catching 5 times, child jumping 5 times, and parent jumping 5 times.

If you have any questions, please call Katie Scott-Andrews at (313) 473-9509 or email her at katieqa@umich.edu**.**

THANK YOU FOR YOUR COOPERATION! ☺

Appendix C Phase III Forms

Home Environment Assessment

This assessment was completed before the semi-structured interview by the interviewer. This assessment provided more information about the home environment.

1. What type of home do the participants live in?

   a. Single family home
   b. Townhome
   c. Apartment
   d. Other:_______________

2. Inside the home is there ample space for children to play or move around freely? *(play room, large spaces)*

   a. Strongly disagree
   b. Disagree
   c. Undecided
   d. Agree
   e. Strongly agree

3. Outside the home is there ample space for children to play or move around freely? (*backyard, front yard, garden, etc.*)

   a. Strongly disagree
   b. Disagree
   c. Undecided
   d. Agree
   e. Strongly agree

4. What is the condition of this space?

   a. Very poor condition
   b. Poor condition
   c. Fair condition
   d. Good condition
   e. Excellent condition

5. Was there any type of physical activity equipment visible? *(Check all that apply)*

☐ Bike

☐ Skateboard/scooter

☐ Exercise equipment

☐ Other:__________________

☐ Movement games

☐ Sports balls and/or equipment

☐ Playground

Semi-Structured Interview Protocol

The following protocol represents the format and sequence for conducting the semi-structured interview to collect information pertaining to parents' and children's knowledge, perceptions, and engagement about physical activity and motor skills.

Notes to interviewer:
- The Participant and Interviewer will sign onto password protected Zoom Call.
-This should take approximately 15-30 minutes.
-Introduction to the interview should begin casually and convey themes (does not have to be verbatim).

Consent and Assent Forms will be sent through Michigan Box Prior to the Interview

Hi _______________, I appreciate both of you for taking the time to speak with me today and take part in the second phase of this study. I'm _______________, and as you may remember from the first part of this study I am collecting information concerning family's beliefs about physical activity behaviors and motor skills. The information from this study will help provide valuable insight into influences of physical activity and motor skills from your perspective. In addition, it will support the development of programs to increase physical activity levels and motor skills. I will record this interview and then after the interview I will type up notes and contact you to check for accuracy. You may change or alter your responses in any way.
First, I have received your Consent and Assent forms, but want to go over a few items. Your participation in the interview is completely voluntary. You may refuse to answer any questions that makes either of you uncomfortable, or you may withdraw from the interview at any time without consequence. Based upon your responses in this interview will take about 15-30 minutes to complete.
I also want you to know the interview results will be strictly confidential. Excerpts of the interview may be published or made public, but your names or any other identifying details will not be revealed. The only people who will have access to the tape recording will be the research team. As participants today, you will each receive a of $10 Visa gift card for your time.

Before we start, I want to review a few points:

- Today we are going to cover a range of topics regarding physical activity and motor skills for you, your child, and your family.
- There are **no right or wrong answers** here- we really just want your thoughts.
- **Most importantly- please just take your time and feel free to talk about whatever comes to mind with these questions**; we just want to know as much as possible and to learn more from you and your child.
- Lastly, **I am going to be recording** this session, so please try to speak as clearly as you can, to make sure your comments are heard.

Do you have any questions right now about what I'm doing, why I'm doing it, or what I will do with this information? If you have any as we go along, or after the interview is over, please feel free to ask them. Are you ready?

Press "RECORD" on the Zoom Application.

Note to interviewer:

For subsequent questions, if respondent asks for clarification regarding a question, it's okay to respond, <u>"It's up to you, just [repeat question]?"</u>

For some questions, respondents may need time to think about their responses. Be sure to wait for someone to speak up.

Begin with Home Environment Assessment

Interview Guide

1. First, I want to start by having a discussion about your knowledge about physical activity and motor skills.
    a. What does physical activity mean to both of you?
    b. What does motor skills mean to both of you?
        - **Probe:** Examples of physical activity? Examples of motor skills?
        - **Probe:** Do you think motor skills are important to work on in your family?

2. What are your general thoughts about physical activity?
        - **Probe:** Do you enjoy it? Do you dislike it? What would you rather be doing?
    a. What are your favorite active activities to do?
        - **Probe:** Sports you participate in or want to participate in? Things you might want to try one day?
    b. What is your role in being physically active?
        - **Probe:** As parents encourage? Support? As children motivation? Siblings?
        - **Probe:** Tell me about that.

3. Tell me about your family's experiences with physical activity and motor skills.
    a. Do you think family members are fairly active?
    b. Do you think family members are skilled?
        - **Probe:** What do you both do to get active? Do you work on motor skills? Do you do it together? Do you do it separate?

4. What are types of physical activity behaviors that your family regularly participates in?

a. How has COVID-19 impacted your physical activity?
a. Do you do belong to a gym? Do you like to go to the park? Do you do afterschool activities?
    - **Probe:** How often? Where? Individual activities? Activities together? Separate?

5. What do you think are the biggest barriers for your family to be physically active?
    a. **Probe:** Time? Work or School? Availability? Accessibility? Enjoyment? Interests? Screen time? Weather? Discuss more about COVID-19.

6. What do you think helps your family to be physically active?
    a. **Probe:** Tell me more about that. Do you want to be active as a family?
    b. **Probe:** Spending time together as a family?

7. What do you think you could do to increase [or maintain] your family's physical activity and motor skills?
    a. **Probe:** Tell me more about that

8. Is there anything you might add or something we did not discuss?

Thank you for taking the time to share your insights with me. I will send you a link to University of Michigan Box where you will find your transcribed interview within the next few days, so you can read it over and amend any of your responses if you like.

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