An Examination of the Influence of Guided Practice on Overhand Throwing Competence in Preschool Children in a Mastery Motivational Climate

by

Jerraco Leontae Johnson

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 3, 2019

Keywords: Fundamental Motor Skills, Health Instruction, Motor Skill Development, Performance

Approved by

Dr. Mary Rudisill, Co-chair, Wayne T. Smith Distinguished Professor of Kinesiology
Dr. Peter Hastie, Co-chair, Wayne T. Smith Distinguished Professor of Kinesiology
Dr. Danielle Wadsworth, Associate Professor of Kinesiology
Dr. Joni Lakin, Associate Professor of Educational Foundations. Leadership, and Technology

Abstract

It is widely accepted that fundamental motor skills (FMS) are considered the building blocks for successful participation in sports and physical activity for children, adolescents, and adults (Haywood & Getchell, 2014), and that individuals must be able to master these skill patterns before they can engage in more complex movement patterns, games, and activities. To date, several studies have shown significant changes in fundamental motor skill development in children as a result of being exposed to purposeful motor-skill interventions (Tompsett, Sanders, Taylor, & Cobley, 2017). Previous research has highlighted the importance of skill practice, but there is little information on how much or what type of practice is necessary for optimal skill development in young children. Of the FMS, overhand throwing is an important and complex action that is widely used and assimilated into a variety of sports. Moreover, there is evidence that fundamental motor skill competence, including overhand throwing, during childhood predicts adolescent and adult physical activity (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Jaakkola, Yli-Piipari, Huotari, Watt, & Liukkonen, 2016; Stodden, Langendorfer, & Roberton, 2009). Therefore, the importance of the development of overhand throwing may be extremely critical for future participation in many sports and games and in some cases physical activity participation.

A majority of the overhand throwing research has been conducted in controlled laboratory settings. Experimental designs such as these have the potential to limit the variability in the amount of throwing practice, and while useful, may lack external validity to physical

education settings where there are inherent inconsistencies in the number of practice trials across different students. To address this gap in the throwing development literature and to determine the progressions of development for throwing, variability in the number of throwing practice trials between subjects should be investigated.

The purpose of this study was to determine the influence of the amount of guided throwing practice (the aggregation of the observable measures of the number of visits at the throwing station, the total amount of time spent at the station, and the number of successful trials participants attempt while at the station.) during a mastery motivational climate physical education program on different aspects of throwing competence of preschool-age children. In order to achieve the goals of the study, three specific research questions were posed. These include: (a) Does children's throwing competence change as a result of exposure to a mastery motivational climate physical education program? (b) To what extent does the volume of guided throwing practice influence gains in throwing competence? And c) To what extent do children's characteristics (e.g., gender and initial skill level) relate to throwing practice behaviors?

Participants in this study included 54 preschoolers (24 boys, 30 girls) between the ages of 3- and 5-years old participated in a mastery motivational climate intervention that was manipulated according to Ames' (1992a, 1992b) TARGET structures. The children participated in bi-weekly (Tuesday and Thursday) 30-minute motor skill sessions over 7 weeks for a total of 13 sessions. Pre- and post-test overhand throwing competency was measured in three ways (TGMD-3, developmental sequence for throwing, and throwing velocity). Throwing practice behaviors (visits, time, and trials) were then coded for each participant using video recordings

from the sessions. A principle 'component' variable was created to represent the total amount of throwing practice by grouping throwing time, visits, and trials. The results identified the first factor as very strong, accounting for 86% of the variance in practice visits, practice time, and practice trials.

Results from paired-samples *t*-tests revealed significant gains in throwing proficiency by the children from pre- to post-test on all three dependent measures. Additionally, results from multiple stepwise linear regressions highlighted that guided throwing practice volume accounted for 19% (TGMD), 52% (developmental sequence), and 60% (velocity) of the explained variance, respectively. Furthermore, findings also revealed that boys and children who were considered higher skilled spent more time practicing throwing. Together, these findings provide empirical evidence of the importance of guided practice for overhand throwing. Future research should continue to examine the relationship between guided practice and skill improvement in high autonomous and naturalistic settings to enhance FMS development in young children.

Acknowledgments

First off, I want to give honor to God for guiding me through this journey. Your word says, “I can do all things through CHRIST who strengthens me.” – Philippians 4:13. This process has continually revealed to me that without you nothing is possible, but with you ALL THINGS ARE POSSIBLE. I am forever grateful for your love, grace, mercy, kindness, and your favor.

To Grandma Joyce and Grandma Bobbie, I thank God daily for blessing me with two Grandmothers like you. Thank you both for your many prayers and your unwavering love. The overwhelming faith you two have exemplified has been inspiring, especially in the face of adversity. Grandma Joyce, you have battled with cancer with the utmost dignity, grace, and strength. You drive yourself to all of your radiation appointments each day without so much as a mumble or a groan. Grandma Bobbie, you lost your husband of 49 years, yet you’ve managed to hold our family together with your strength. You two have given me a new perspective on life and I only pray that I can become half of the individuals you are.

To both of my late Grandfathers, J.L and George, I hope that I have made you both proud and that you are smiling down on me. Continue to watch over me.

To my wonderful Mother, Valencia, how did I become so blessed to have a mama like you? There are not enough words to express how much love and appreciation I have for you. For as long as I can remember, you’ve always encouraged me to chase after my dreams. You sacrificed so much for me to get to this point, even though I was too young to appreciate it growing up. I’ve never had to go without, even if that meant that you did. When the house

burned down and everyone was so sad, yet you kept reminding us that life was not about material things. You were just thankful that nobody got hurt. You went to church the next day like any other Sunday. You may have lost your home but never lost your praise. You are the epitome of a strong, God-fearing woman.

To my Father, Jerald, our relationship has grown so much and I hope it continues to get stronger. Thank you for not only teaching me to work hard, but showing me by example as well. I'm sure those 12 hour days in those factories doing manual labor get long. But you always try and make the best of whatever situation you're faced with. Most importantly, thank you for teaching me how to take the initiative and take care of business. Your work ethic is unmatched and has rubbed off on me and inspired me to keep pushing through some very long nights. Thank you for always being there whenever I need you.

To my siblings: Donte, Marques, LaMonica, Telina, Jeremy, Rahheem, Travon, Diana, Greg, LaShonica, Darius, and Ebonie, I am grateful for each of you. You guys inspire me! I strive to make you proud. Thank you for all of the advice over the years. I know that we are all grown and have our own lives, but I find comfort in knowing that I can always call any of you if I need help with anything. Your support has not gone unnoticed. Thank you for allowing me to experience the joy of being an Uncle to your children. You guys are all wonderful parents.

Uncle Jimmy, Aunt Lynn, Uncle Greg, Aunt Dena, Uncle Thomas, and Uncle Bo. Thanks for all that you've taught and instilled in me. You all have taught me lessons that I will take with me forever. Thanks for all the times you've helped me and the love you've shown.

To my Big Mama, Rosie Lee Allen, thanks for being the Matriarch of the best family ever! To my many many great Aunts and Uncles (RIP Pearl), thanks for showing me what being a family is all about. You all are always there for each other and have been super encouraging.

To all of my many, many, many cousins both near and far (too many to name!), I love y'all from the bottom of my heart. The Allen, Roberts, Gay, and Brand Families are the greatest! Special thanks to my Cousin's LaTesha, Nikki, Kelli, LaShantae, Tia, Dornita, Jeremy, Adrienne, Shawn, Denzel, Antonio, Victor, Robyn, Othel, Olivia, Kim, Yolanda, Paris, Triona, and Tynesha for your special love. To the rest of my wonderful family, there is no way that I could have done this without your amazing love and support. A family that prays together, stays together. Let's all keep striving for greatness!

Dr. Rudisill (RIP Roy) and Dr. Hastie, you have somehow managed to make this process so enjoyable. Thank you for extending an offer for me to complete my studies here at Auburn University. You both saw potential in me that I did not know I possessed. Thanks for helping me realize that potential. With the skills that you have equipped me with and helped me develop, I am confident that I will be successful at THE OHIO STATE UNIVERSITY and beyond. Your guidance and mentorship has been tremendous. I know that I can be impatient, but you both have always been so quick to respond. Thanks for always being there whenever I needed anything whether it was related to school or not. Dr. Rudisill, you never hesitated to encourage me to go home whenever something was going on with family. Dr. Hastie, you drove me up to Atlanta and helped me find a new car. You guys are just great people and I am fortunate to have taken

this journey with you. The world needs more people like you. I do realize that for some people this experience is not very smooth and joyous and I do not take that for granted.

Dr. Wadsworth (and the Wadsquad!), thank you for giving me guidance and support throughout this process. You have taught me so much about teamwork and what it takes to be a good team player. Your suggestions have been appreciated and you have been a joy to interact with.

Dr. Lakin, thank you for all of your help with the statistics for this project. Your assistance was greatly appreciated.

Dr. Melody Russell, thanks for being so willing to serve as my external reader. You have always been active within the School of Kinesiology. Thanks for all of your support.

Dr. Jared Russell, thanks for all of your advice and guidance during my time here at Auburn. I would not be in this position if you were not committed to increasing the diversity and inclusion both here at Auburn and within the field of Kinesiology. Your many visits to the Graduate School Workshop at Morehouse helped me realize that I had options beyond undergraduate studies. Your efforts are appreciated and have not gone unnoticed. You are the definition of a Morehouse brother and I hope to be in your position to help other young African-American men one day.

To the School of Kinesiology and the Auburn Family, I am grateful for all of you. From the Faculty and Staff, Administrators, GTA's, and everyone in between! You guys welcomed me with open arms from day one and have been my family away from home. Ms. Rita thanks for your wonderful hugs. Dr. Pangelinan thanks for being an unofficial committee member and always including me in your lab. Dr. Pascoe thanks for helping me get involved with track and field here and for often letting me accompany you on your awesome tours of our building. Dr. (mama) Brock, thanks for helping me with my teaching and giving me the nickname Goldfish. Dr. Buchanan thanks for letting me help at LCYDC. Dr. Weimar your energy is contagious and you rock! Dr. Kavazis and Dr. Brown thanks for being a listening ear and for your advice.

To Darden Head Start Center, thanks for allowing me to conduct my study at your site. Mrs. Sue, Mrs. Stacey, Ms. Ella, Mrs. Karen, Mrs. Yolanda, and Mrs. Lewis you all were great to work with. I cannot imagine a better place or better people to work with. To all of the Children at Darden, you all are forever in my heart and in my mind. Mr. JERRACO LOVES Y'ALL FOREVER! Tuesday's and Thursday's with you all were hands down the best days of the week. Thank you to all of the Teachers and the Parents as well for everything they do.

Thank you to the best research team that I could ever ask for! Julia Sassi, Michael Morris, Monaye Merritt, Kathryn Clardy, Alexandra Venezia, Vanessa Chapman, Toni Ansley, and all of the undergrads. Teamwork makes the dream work!

To my many friends and supporters, thanks for keeping me balanced. Mrs. Taylor, Mrs. Stovall, Mrs. Lillis, Mrs. Baker, Ms. Shellie Guy, Mr. and Mrs. Randle, Mr. and Mrs. Muskeyvalley, Ms. Rosalind Duncan (RIP Taylor), DeMykhal Teague (BEST FRIEND!), Marc Pressley, Ms. Lisa, Ms. Vernice, DeMar Bester (RIP), Alyssa Decker, Mia Mayberry, Briah Nunn, Tekiah Banks, T'Keyah Loggins, Larry Hall, Chasson Randle, Brandi Bomar, Telis Garcia, Shannon Frink, Moriah Wallace, Jatavia Wright, Doug Wilson, Byron Brantley, Maya

Iman, and all of my many SPELHOUSE and SIUE track and field teammates, friends, and family, and many more (There's no way I could name you all!)

To my Auburn friends and family thank you! AUBGPSA members (past and present), DJ, BJ, Mario, Jade, Jalen, Shanel, Daniel, Taylor J, Shaniqua, Kayla, Lauren, Courtney, Christin, Erin, noonball colleagues, and many more. You guys have all kept me encouraged.

Thanks to those who have come before me, Dr. Michelle Vaughn, Dr. Desmond Delk, Dr. Simone May, Dr. Chantel Tremitiere, Dr. Korey Boyd, Dr. Claire Bridges, Dr. Ruby Ellis, Dr. Christopher Wilburn, Dr. Adelola Adeyemo, and Dr. Portia Williams. Future Doctors – Julia Sassi, Monaye Merritt, Cory Dixon, Michael Morris, and the rest of the pigpen; you're up next! Keep going!

Table of Contents

List of Tables

Chapter I: Introduction

Fundamental motor skills (FMS) typically emerge in children between the ages of 1 and 7 years (Burton & Miller, 1998) and are skills that children are expected to learn since they are not acquired as a result of the maturational process alone (Payne & Isaacs, 2007). These skills can be classified as either locomotor skills or object control skills. Locomotor skills are actions that move the body through space (e.g., running and jumping), while object control skills require the use of hands and feet to manipulate objects (e.g., throwing and kicking) (Haywood & Getchell, 2014).

It is widely accepted that FMS are considered the building blocks for successful participation in sports and physical activity for children, adolescents, and adults (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Clark & Metcalfe, 2002; Gabbard, 2011; Gallahue & Ozmun, 1998; Haywood & Getchell, 2014; Okely, Booth, & Patterson, 2001a; Rovegno & Bandhauer, 2016; Seefeldt, 1980). Individuals must be able to master these skill patterns before they can engage in more complex movement patterns, games, and activities. To date, several studies have shown significant changes in fundamental motor skill development in children as a result of being exposed to purposeful motor-skill interventions (see review by Tompsett, Sanders, Taylor, & Cobley, 2017). Equally relevant is research that suggests children who are not given opportunities to practice these often demonstrate delays in fundamental motor skill development (Goodway & Rudisill, 1997; Hamilton, Goodway, & Haubenstricker, 1999). Consequently, it is necessary to improve our understanding of the most effective interventions that allow for both skill practice and fundamental motor skill improvements in young children.

Of the object control skills, overhand throwing is an important and complex action that is widely used in sports (i.e., baseball and softball). From a research perspective, the biggest skill difference between boys and girls fundamental motor skills has been found in overhand throwing (Hyde, 2005). These differences have been found as early as age as five years of age (Butterfield, Angell, & Mason, 2012; Nelson, Thomas, Nelson, & Abraham, 1986) and continue to increase by age eight (Nelson, Thomas, & Nelson, 1991). Additionally, the basic overhand throwing motion is assimilated into a variety of other sports skills such as volleyball, tennis, and badminton (Butterfield & Loovis, 1993; East & Hensley, 1985). Moreover, there is evidence that fundamental motor skill competence, including overhand throwing, during childhood predicts adolescent and adult physical activity (Barnett et al., 2009; Jaakkola et al., 2016; Stodden et al., 2009). In fact, Stodden et al. (2009) showed that throwing product scores (velocity) is one of the major predictors of adult physical fitness levels. Therefore, the importance of the development of overhand throwing is extremely critical for future participation in many sports and games and in some cases physical activity participation.

Statement of the problem

Many studies within the field of fundamental motor skill development have examined the efficacy of motor skill interventions on overhand throwing competence in children (Capio, Poolton, Sit, Holmstrom, & Masters, 2013; Chen, Mason, Hypnar, & Bennett, 2016; Cohen, Goodway, & Lidor, 2012; Lorson & Goodway, 2007; Stodden, 2002). However, much of this research has focused on the prevision of cues and feedback, and is conducted in controlled environments. Experimental designs such as these have the potential to limit the variability in the amount of throwing practice, and while useful, may lack external validity to physical education settings where there are inherent inconsistencies in the number of practice trials across different students. To address this gap in the throwing development literature and to determine the progressions of development for throwing, variability in the number of throwing practice trials between subjects should be investigated. Further, in order to replicate that variability in throwing practice, a climate that is focused on skill development is desirable. Theoretically, achievement behavior is improved when the motivational climate of a particular instructional setting allows for high levels of autonomy and a mastery orientation for all learners (Ames, 1992a, 1992b; Epstein, 1989). Due to the autonomous nature of a mastery motivational climate, it appears to be a suitable vehicle to examine the effects of practice on overhand throwing given that the persistence of throwing by the children in this environment will be nearly exclusively based on their personal choice to attend the throwing station.

Purpose and Significance of the Study

Given the value of investigating throwing development within a naturalistic setting, and given that significant relationship that is posited to exist between practice and skill development (Silverman, 1985) the purpose of this study was to determine the influence of the amount of guided throwing practice during a mastery motivational climate intervention on different aspects of throwing competence of preschool-age children. Guided throwing practice in this study was the aggregation of the observable measures of "the number of visits at the throwing station", "the total amount of time spent at the station"," and the number of successful trials participants attempt while at the station." Given that the bulk of research on overhand throwing consists of studies where some researchers have been more interested in throwing force and maximum ball velocity (Roberton, Halverson, Langendorfer, & Williams, 1979; Roberton & Konczak, 2001), while others have been equally interested in throwing form (i.e., technique and developmental level) (Stodden, Langendorfer, Fleisig, & Andrews, 2006a; 2006b), throwing competence in this case was measured in three ways. These included the process measures of overhand throwing per the third edition of the Test of Gross and Motor Development (TGMD-3: Ulrich, 2013), as well as Roberton and Halverson's (1984) developmental sequence for throwing. The product measure of throwing velocity was also measured. Because fundamental motor skill development is critical, it is important to identify different practice behaviors of young children (in a non-controlled environment), and to determine how these behaviors relate to skill improvement. As noted, a mastery motivational climate appears to be an effective means by which to gain variability in the amount of throwing practice between individuals (as opposed to a set number of throws for participants). The results of this study should contribute to the field of motor development by providing a richer picture of the impact of practice on the throwing skill development of preschool aged children when exposed to a high autonomy (mastery motivational) climate. In the future, this study's findings may help lead to the identification of a specific amount of practice that is necessary to enhance overhand throwing in young children, which has been found to be related to overall fitness in young adults (Stodden et al., 2009).

Research Questions and Hypotheses

Research Question #1: Does children throwing competency change as a result of exposure to mastery climate? (as measured by the TGMD-3 assessment, Roberton and Halverson's developmental sequence for throwing, and throwing velocity).

Hypothesis #1: Students who are exposed to a mastery motivational climate will demonstrate significant improvement in throwing competency (as measured by the TGMD-3 assessment, Roberton and Halverson's developmental sequence for throwing, and throwing velocity).

Research Question #2: What is the extent to which guided throwing practice volume influences gains in TGMD throwing competency (as measured by the TGMD-3 assessment)?

Hypothesis #2: Guided throwing practice volume will explain a significant amount of variance in post-test TGMD scores (controlling for pre-TGMD test scores). a

Research Question #3: What is the extent to which guided throwing practice volume influences gains in Roberton and Halverson's developmental sequence throwing competency?

Hypothesis #3: Guided throwing practice volume will explain a significant amount of variance in post-test Roberton and Halverson's developmental sequence for throwing (controlling for pre-developmental sequence test scores).

Research Question #4: What is the extent to which guided throwing practice volume influences gains in throwing velocity?

Hypothesis #4: Guided throwing practice volume will explain a significant amount of variance in post-test velocity score (controlling for pre-test velocity scores).

Research Question #5: To what extent do children's characteristics (e.g., gender and initial skill level) relate to throwing practice behaviors?

Hypothesis #5: Children with higher skill level and boys will engage in a higher amount of throwing practice during the intervention.

Assumptions

The intervention used in this study was not expected to fully develop an advanced throwing pattern (as defined by Roberton and Halverson's developmental sequence for throwing) in every child. It was not a reasonably expected outcome of the instruction to have all children throwing at the most advanced pattern due to the limited amount of time allotted for the intervention and practice, and based on the skill level of the participants upon entry into the intervention. Rather, the goal was to promote the development of the most advanced pattern for each individual child.

Another assumption of this study was that maturation would not be a factor in throwing improvement. The entire length of data collection, including pre- and post-test, was approximately ten weeks. Ten weeks is not a length of time for significant maturation effects (Malina & Bauchard, 1991).

Delimitations

The following were delimitations of this study:

1. Participants of this study were preschool-aged children enrolled in a Head Start program located in a rural, southeastern town in the United States.
2. Participants were exposed to a mastery motivational climate during outdoor play.
3. The results of this study are delimited to the mastery motivational climate program. The program met twice a week for seven weeks. A program that meets more or less frequently may have differing results. The student to teacher ratio within this program was approximately 18:1. A different ratio of students to teachers may have yielded different results.
4. The results of this study are also delimited to these particular teachers. The study does not attempt to determine if other physical education teachers or preservice physical education teachers would achieve similar results in using this instructional approach. The instructor who implemented the motor skill intervention had over twenty years of experience with implementing mastery motivational climates
5. The dependent measures were TGMD-3 throwing, Roberton and Halverson's developmental sequence for throwing, and throwing velocity.

Limitations

The following were limitations of this study:

1. Children were from one Head Start center, a majority of whom were African American, were assessed. Therefore, the findings are not generalizable to other population samples.
2. The conditions of interest were implemented in a naturalistic setting. Although care was taken to control for variables that may have impacted the results of the study, it was impossible to control for all variables.
3. The amount of instruction and feedback given to each participant was not controlled for during this study. In naturalistic physical education settings, all students do not receive identical amounts of instruction and feedback. Controlling the feedback and instruction was therefore not a goal of this study. However, age and skill appropriate feedback and instruction was provided to all participants during the intervention on an individual basis.
4. The influence of the levels of the independent variable (guided throwing practice volume) was the inability to control practice time spent in throwing activities outside of the school. The amount of practice time outside of school physical education was not controlled or tracked.

Definition of Terms

Achievement goal theory: Identifies the goals, purposes, and reasons that direct achievement-related behaviors (Maehr & Zusho, 2009).

Component approach: The component approach is a developmental sequence for the overarm throw describing changes in different body sections. A component is one particular body segment or a joint action of the body (Langendorfer & Roberton, 2002a). The component approach examines five components: step, trunk, backswing, humerus, and forearm.

Component: A particular body segment of the throw (Langendorfer & Roberton, 2002a).

Developmentally appropriate: Lessons provided to children should consider factors such as the environment, equipment, and constraints of the activities to ensure that all aspects match with the child's physical, social, and cognitive development (Gagen & Getchell, 2008).

Fundamental motor skills (FMS): An organized series of basic movements that involve the combination of movement patterns of two or more body segments (Gallahue & Donnelly, 2007).

Guided throwing practice volume: Describes the amount of overhand throwing practice (i.e., time, visits, and trials) that children engage in during this study.

Head Start center: Refers to center-based childcare for children ages 3 to 5 years for families with low income.

Level: A level is the description of the different movements within each component; each of these levels is organized in a hierarchal order from least mature to most mature (Roberton, 1978a). Each component of overhand throwing is associated with a different number of levels ranging from three to five.

Locomotor skills: Locomotor skills are actions that move the body through space including running, jumping, skipping, hopping, galloping, and sliding (Ulrich, 2013).

Mastery motivational climate: refers to a high autonomy learning environment that emphasizes learning and skill mastery based on exerting maximal effort and self-referenced criteria for determining success.

Mastery-goal orientation: Individuals who adopt this type of orientation desire to learn and become competent for the purpose of mastering tasks and attribute success to effort and hard work (Elliot & Dweck, 1988).

Motor development: The change in motor behavior across the lifespan and the processes that underlie the change (Clark, 1994).

Motor skill interventions: Motor skill interventions consist of developmentally and instructionally appropriate planned movement activities that includes high-quality instruction from trained movement specialists.

Object-control skills (ball skills): Object control skills (also referred to as ball skills) are actions that involve the manipulation of objects with the use of the hands and feet and include overhand and underhand throwing, catching, dribbling, kicking, and striking (Ulrich, 2013).

Performance-goal orientation: Individuals who adopt this type of orientation desire to learn and become competent for the purpose of outperforming others and attribute success and/or failure to ability (Elliot & Dweck, 1988).

Preschool-age children: Includes young children from age 2.5 years to lawful school age. Lawful school age is the minimum age (i.e., children must be 5 years of age on or before September 1, of a given year) at which a child may be admitted to public school kindergarten (State of Alabama, Department of Human Resources, 2006).

Process measures of throwing: Process measurements of throwing are concerned with the throwing form. Throwing form can be assessed using a component approach (Payne & Isaacs, 2017).

Product measures of throwing: Product measurements of throwing are concerned with the end result or the movement outcome. The product measures of throwing have been outcomes such as force, distance, and accuracy (Hamilton & Tate, 2002).

Radar gun: Radar guns assess overhand throwing ball velocity (Halverson, Roberton, & Langendorfer, 1982).

Reliability: The degree to which independent observers agree on what they have observed when using the same definitions and observing the same subjects (Siedentop, Tousignant, & Parker, 1982).

Roberton and Halverson's developmental sequence for throwing: Analyzes the following five components for overarm throw: trunk action (three developmental steps), foot action (four developmental steps), arm backswing (four developmental steps), humerus action (three developmental steps), and forearm action (three developmental steps).

TARGET structure: An acronym that stands for Task, Authority, Recognition, Grouping, Evaluation, and Time. The *task* structure refers to the type of task and task options that are available within a learning environment; *Authority* stresses the importance of teachers and students working collaboratively in the decision making process; *Recognition* refers to the feedback, rewards, and reinforcement that are given within the learning environment; *Grouping* refers to the grouping structure which determines whether, how, and why students who are alike or different are brought together or kept apart for instruction; *Evaluation* refers to the implementation of a system for assessing student progress; and *Time* refers to the time constraints placed on learning, such as the appropriateness of the workload, the pace of instruction, and the amount of time allocated to task completion (Ames, 1992b). The TARGET structures were proposed by Epstein (1988, 1989) and conceptualized by Ames (1992a, 1992b), these environmental factors and instructional cues aid practitioners in organizing their instruction in terms of performance- and mastery-oriented climates and help researchers identify important cues and factors that impact one's achievement goal state.

Test of gross and motor development (TGMD-3): A fundamental motor skill assessment normed for children ages 3 to 11 years of age. This assessment measures children's competence on both locomotor and object control skills.

Summary

This chapter has summarized the background, statement of the problem, the purpose and significance of the study, the research questions and hypotheses, limitations and delimitations, and the definitions of terms. Chapter two includes a review of the related literature concerning fundamental motor skills, overhand throwing, and mastery motivational climates. Chapter three outlines the proposed methods for this study, including the research design; participants and setting; procedures and data collection; the design of the intervention; and the statistical analyses employed to determine the study results. Chapter four highlights the results from this study. Finally, chapter five focuses on the discussion of the findings and the implications of the results.

Chapter II: Literature Review

The primary purpose of this study was to investigate the influence of throwing practice (i.e., time, visits, trials) during a mastery motivational climate intervention on different aspects of throwing competency (i.e., TGMD-3, Roberton and Halverson's developmental sequence for throwing, throwing velocity) of preschool-age children. Therefore, it is necessary to examine the key research outcomes from these areas. First, this review of literature will cover the importance of fundamental motor skill development during the early years. Secondly, the interventions that have investigated fundamental motor skill development in young children are presented. Then, overhand throwing is specifically addressed. Next, throwing assessments are discussed, followed by motor skill interventions that have examined overhand throwing competency in children. Finally, the theoretical underpinnings of mastery motivational climates are described, the key environmental characteristics of the climate are identified, and interventions that have successfully employed these climates are highlighted.

Fundamental Motor Skills

While many definitions of fundamental motor skills (FMS) exist, Gallahue and Donnelly (2007) define FMS as "an organized series of basic movements that involve the combination of movement patterns of two or more body segments" (p.52). FMS are comprised of locomotor skills and object control skills (Haywood & Getchell, 2014). Locomotor skills are actions that move the body through space including running, jumping, skipping, hopping, galloping, and sliding. Object control skills (also referred to as ball skills) are actions that involve the manipulation of objects with the use of the hands and feet and include overhand and underhand throwing, catching, dribbling, kicking, and striking (Ulrich, 2013).

FMS typically emerge in children between the ages of 1 and 7 years (Burton & Miller, 1998), and are skills that children are expected to learn (Payne & Isaacs, 2017). The early childhood years are a critical time for the development of FMS (Clark, 1994). Many motor development researchers have highlighted the importance of the development of fundamental motor skills. For example, Seefeldt (1980) suggested that it is critical for children to break through an imaginary 'proficiency barrier' to become competent in FMS. He argues that competence in these FMS are necessary for participation in sports and games (Seefeldt, 1980, p. 318). Similarly, Gallahue and Ozmun (1998) argued that an individual that fails to achieve proficiency in FMS will inhibit further application and development in specialized sports skills. Likewise, in their mountain of motor development model, Clark and Metcalfe (2002) describe the fundamental motor patterns phase as the "basecamp" to the top of the mountain leading to motor skillfulness. Overall, it is widely accepted that FMS are considered the building blocks for successful participation in sports and physical activity for children, adolescents, and adults (Barnett et al., 2009; Clark & Metcalfe, 2002; Gabbard, 2011; Gallahue & Ozmun, 1998; Haywood & Getchell, 2014; Okely et al., 2001a; Rovegno & Bandhauer, 2016; Seefeldt, 1980).

Further, evidence supports the association between physical activity and FMS competence (Fisher et al., 2005; Houwen, Visscher, Lemmink, & Hartman, 2008; Morgan, Okely, Clidd, Jones, & Baur, 2008; Okely et al., 2001a; Robinson, Wadsworth, & Peoples, 2012). Focusing on the acquisition of FMS in young children is imperative as there is specific evidence that FMS competence during childhood is associated with and predicts adolescent and adult physical activity (Barnett et al., 2009; Erwin & Castelli, 2008; Holfelder & Schott, 2014; Jaakkola et al., 2016; Stodden et al., 2008; 2009). However, these skills are not naturally acquired (Clark, 2005), but in fact must be learned, practiced, and reinforced (Goodway &

Branta, 2003; Valentini & Rudisill, 2004a). Instruction, opportunities for practice, encouragement, and the context of the environment all play important roles in the development of FMS (Gallahue, Ozmun, & Goodway, 2012; Salehi, Sheikh, & Talebrokni, 2017). Equally relevant is research that suggests children who are not given opportunities to practice these skills, and those who lack motor skills, demonstrate delays in FMS development (Goodway & Rudisill, 1997; Hamilton et al., 1999). Nevertheless, recent studies have reported that children from around the world are not competent in their FMS (Goodway, Robinson, & Crowe, 2010; Hardy, Reiten-Reynolds, Espinel, Zask, & Okely, 2012). Thus, it is imperative to identify effective early interventions strategies to enhance the FMS of young children.

Fundamental motor skill interventions. To date, several studies have shown significant improvements in the FMS development of young children due to exposure to purposeful motor-skill interventions. Motor skill interventions consist of developmentally and instructionally appropriate planned movement activities that includes high-quality instruction from trained movement specialists. The following sections will chronologically identify those studies that have been effective in increasing young children's FMS.

Ignico (1991) investigated the impact of a competency-based instruction delivered by pre-service teachers (physical education majors) on Kindergarten children's fundamental motor skills (TGMD). Thirty children participated in the study and were assigned to either a direct-instruction or a control group. The direct-instruction group received a total of 480 minutes of instruction over a 10-week intervention period, while the control group received no instruction (i.e., regularly scheduled free play). Results indicated that children in the competency-based instructional program demonstrated better fundamental motor skills than the control group at post-intervention assessments.

Hamilton et al. (1999) observed the effectiveness of parental involvement on the fundamental motor skills (i.e., TGMD-object control) of preschool children who were at risk for developmental delay. Twenty-seven children between the ages of 3 and 5 years participated in the study and were assigned to either an experimental group (*n* =12) (i.e., parent-assisted motor skill intervention) or a control group (*n* = 15). The experimental group participated in 16, 45-min lessons for 8 weeks (for a total of 720 minutes of instruction), while the control group received no instruction (i.e., regularly scheduled free play). Results revealed the children who participated in the intervention showed significant improvement in their object control skills, while the control group actually performed worse on post-test skills.

Goodway and Branta (2003) examined the influence of a direct-instruction intervention on the fundamental motor skill development (i.e., TGMD) of disadvantaged preschool children. Fifty-nine African-American children between the ages of 4 and 5 years participated in the study and were assigned to a teacher-centered (*n* = 31) (i.e., direct-instruction) or control group (*n* = 28), respectively. The direct-instruction group participated in a 12-week intervention (i.e., 24 sessions, 45 minutes per session) for a total of 1,080 minutes of instruction while the control group received no intervention (i.e., regularly scheduled free play). Results indicated that both groups improved in fundamental motor skills, but the intervention group's improvements were significantly greater than the control group.

Goodway, Crowe, & Ward (2003) observed the impact of a direct-instruction (SKIP program) intervention on the fundamental motor skill development (i.e., TGMD) of Hispanic preschoolers who were at-risk for developmental delay. Sixty-three preschoolers between the ages of 4 and 5 years participated in the study and were assigned to a direct-instruction (*n* = 33) or control group (*n* = 30). The direct-instruction group participated in a 9-week intervention (i.e., 35 minutes per session, twice a week) for a total of 630 minutes of instruction while the control group received no instruction (i.e., regularly scheduled free play). Results showed that the children who received the intervention significantly improved their fundamental motor skills, while the control group showed no increases in skills.

Apache (2005) also investigated the influence of a child-facilitated (i.e., activity-based, high-autonomy) intervention and a direct instruction intervention on the fundamental motor skill performance (i.e., locomotor and object-control skills) of preschool children who were developmentally delayed or at-risk for developmental delays. Fifty-six children (28 in each group) between the ages of 3 and 6 years participated in the study and were randomly assigned to either condition. Both groups participated in 30 minute sessions, three days a week for 15-weeks (A total of 1,350 minutes). Results indicated that students in the child-facilitated (i.e., high-autonomy) intervention group demonstrated better locomotor and object control motor skills than the students in the direct-instruction group.

Deli, Bakle, and Zachopoulou (2006) studied the influence of a movement program intervention and a movement program with music intervention on the fundamental motor skills (TGMD) of kindergarten children who were typically-developing. Seventy-five children participated in the study and were assigned to a movement program, a music and movement program, or control group. Both experimental groups participated in a 10-week intervention (a total of 700 minutes of instruction) while the control group participated in free-play and received no formal instruction. Results indicated that both experimental groups demonstrated better locomotor skills than the students in the control group.

More recently, Hamilton and colleagues (2017) recently examined the effects of a 16-week motor skill intervention on Hispanic preschool children from low socioeconomic (SES) backgrounds. One hundred and forty-eight children participated in the study and were randomly assigned to either an intervention (*n* = 74) or control group (*n* = 75). The children in the intervention group participated in 16 weekly, 50-min lessons (for a total of 800 minutes of instruction), while the control group participated in free-play and received no formal instruction. The children's FMS were assessed using the Peabody Developmental Motor Scales-2 (PDMS-2), which includes locomotion and object manipulation (i.e., object control) as two of the six subsets. The findings revealed that although the intervention group showed significant overall motor skills improvement, there were no group differences for the locomotion and object manipulation subtests.

Similarly, another study by Bardid and colleagues (2017) observed the effectiveness of a 30-week, fundamental motor skill community-based intervention entitled "Multimove for Kids." The study included 992 children between the ages of 3 and 8 years from a total of 50 sites that were purposively selected based on the setting (i.e., school and day care center) and geographic location. The intervention group participated in weekly, 60-min sessions (for a total of 1,800 minutes of instruction) that were offered in the community settings. The intervention was delivered by a trained local instructor (i.e., school teachers or caregivers). The Multimove program focused on numerous FMS. Children were assessed using the TGMD-2 before and after the intervention. Results highlighted a significantly higher gain in both locomotor and object control skills for the intervention group. The results also indicated gender differences between boys and girls, as girls were significantly less skilled in object control skills. This is consistent with previous literature (Butterfield, Angell, & Mason, 2012; Goodway et al., 2010; Thomas, Michael, & Gallagher, 1994; Thomas & Thomas, 1988).

The studies detailed above, on the whole, suggest that motor skill interventions for young children result in significantly better FMS development when compared to children that only receive free-play. Moreover, a meta-analysis by Logan, Robinson, Wilson, & Lucas (2012) examined the effectiveness of motor skill interventions in children and reported evidence that motor skill interventions are effective strategies for improving FMS competence in children. As the purpose of this study is solely on overhand throwing, the following section will identify the reason why overhand throwing was chosen, describe different types of assessments that have been used to examine overhand throwing, and explore different constraints that may influence throwing. Finally, different motor skill and instructional interventions designed specifically to enhance overhand throwing in children are highlighted.

Overhand Throwing

Throwing is one of the most important object control skills as it is used in sports such as baseball and softball. The throwing motion is incorporated in a variety of sport skills such as the tennis serve, the overhead clear in badminton, and the volleyball serve (Butterfield & Loovis, 1993; East & Hensley, 1985). Due to the wide use of the throwing motion, the development of throwing could be considered foundational to succeed and enjoy sporting and games. Throwing competence in children has also been found to be related to overall fitness in young adults (Stodden et al., 2009) and exists on a wide variety of FMS assessments.

Throwing assessments. Changes in throwing can be assessed using both product and process measurements. Both types of measurements are of equal importance. Product measurements are concerned with the end result or the movement outcome, while product measures examine the actual movement itself and is less concerned with the end result (Payne & Isaacs, 2017). The product measures of throwing have been outcomes such as force, distance, and accuracy (Hamilton & Tate, 2002). Radar guns have also been used to assess ball velocity (Halverson et al., 1982). These product scores can be useful in determining the influence of constraints on the overall performance of the throw (Roberton & Konczak, 2001).

Process measures are also useful assessments as they can highlight changes in the movements of the throw. In fact, studies have shown that a change can occur in the process of throwing, without corresponding changes in the outcome (Halverson & Roberton, 1979, Halverson et al., 1982; Halverson, Roberton, Safrit, & Roberts, 1977). The form of throwing is of particular importance as physical educators have had more success in changing form as opposed to product measures with the limited time they have for instruction (Halverson & Roberton, 1979; Thomas et al., 1994).

The component approach for assessing throwing is considered a third approach. Roberton (1977) created a developmental model for throwing by reducing the throw into body components (See Table 2 for a summary of each body component of throwing). This approach focuses on five components of overarm throwing: the step, trunk, backswing, humerus, and forearm. It is possible for individuals to be at different stages within each component as they are not perfectly correlated nor completely independent (Langendorfer & Roberton, 2002a). Thus, changes in component levels may occur at different times and different rates depending on the component.

Influences on throwing development. Newell's (1984) constraint model has provided a framework to classify factors that impact throwing development into individual, task, and environmental constraints. Individual constraints are factors such as body size and coordination, while task constraints could include the goal of the activity or equipment (Barret & Burton, 2002). Examples of environmental constraints are characteristics of the physical or sociocultural environment (Gagen & Getchell, 2004). The majority of overhand throwing studies have occurred in two contexts; controlled practice settings (Robertson & Halverson, 1984) and game-like settings (Barrett & Burton, 2002), each of which can be used to determine variations in throwing patterns based on individual, task, and environmental constraints (Newell, 1984). Majority of the studies have occurred in controlled practice settings, where the participant throws at a desired target from a designated position. In this manner, the stability of the testing environment is considered to be stable (DiRocco & Roberton, 1981; Roberton & Konczak, 2001).

Overhand throwing interventions. Within the studies of FMS development, many researchers have examined the efficacy of motor skill interventions specifically on overhand throwing competence in children. To begin with, Dusenberry (1952) examined the effects of instruction on throwing distance of young children ages 3 to 7 years. 56 participants were evenly split into two groups. One group received instruction and practice in throwing twice a week for three weeks. The other group only received practice. Children in the instruction group revealed significantly greater improvements in throwing distance. These results suggest that instruction in throwing is more beneficial than the effects of the maturational process and general practice alone.

Later on, Halverson and Roberton (1979) studied the influence of an 8-week movement program on throwing in kindergarten children. Children were assigned to either a movement program with instruction, the same program with no throwing instruction, or a control group that received neither. The group that received throwing instruction improved significantly better than the other two groups. These results suggest that throwing must be specifically targeted during instruction.

Additionally, Fronske, Blakemore, and Abendroth-Smith (1997) examined the effects of critical cues on overhand efficiency of elementary school children. A total of 180 third and fourth grade students were assessed using Roberton's developmental sequence for throwing (Roberton, 1984). Children who performed at levels one or two (*n*=44) were targeted for intervention. Participants were then randomly assigned to either a cue or non-cue group. Children were then reassessed and threw three tennis balls as far as they could. The intervention lasted for 5 days, in which both groups threw a total of 318 balls for both accuracy and distance. The experimental group received feedback and cues on the foot position, the backswing, and the release position, whereas the control group only received direction on where and how to stand. Results indicated that cue group demonstrated better throwing form and throwing distance than the control group at post-test.

Thereafter, Adams (2001) also investigated the effectiveness of three instructional strategies on the overarm throwing force of preadolescent females between the ages of 8 and 10 years. Thirty-six participants, who were not competent in throwing, were randomly assigned to a correct model plus verbal descriptions (CMVD) group, a learning model plus verbal descriptions (LMVD) group, or a verbal descriptions (VD) only group. Changes in overarm throwing performance was measured across each of four sessions using Roberton's developmental sequence table (Roberton, 1984, p.74). During the intervention, each participant completed five blocks of five practice trials over three days. There was a total of 75 practice trials for each subject, in which they were asked to throw as hard as possible at a wall approximately 50 feet away. Results indicated that all groups improved on throwing form, regardless of instructional strategy used.

Later, a study by Garcia and Garcia (2002) qualitatively examined the developmental changes in overhand throwing of six children from ages 1 year 9 months to 5 years. Six children were assessed using the five stages of the developmental sequence of throwing (Haubenstricker, Branta, & Seefeldt, 1983). The children's participation in a motor development program was observed for two years. All throws (n = 3,649) were recorded and analyzed, field notes were collected, and interviews were conducted to describe how learning during the overhand throwing activity occurred. The results suggest that the sequence of throwing is not linear, but rather backward and forward to adjacent and nonadjacent stages. The field notes produced three salient themes: (a) motivation; (b) body awareness; and (c) the learning context all affected the number of trials, understanding, and thus the improvement of throwing form.

Since then, Lorson and Goodway (2007) measured the influence of critical cues and task constraints on body-component levels (i.e., Roberton's developmental sequence of throwing) and throwing velocity. Eighty-one second and third graders participated in the study and were systematically assigned to one of four instructional strategies (cue, task, task-feedback, and comparison strategy). Participants received feedback over a fifteen-trial practice session. The cue strategy condition included one of five critical cues after each trial based on their performance. They also received feedback on the speed of the throw. The task-feedback strategy condition received prompts to throw the ball hard and fast in addition to receiving feedback about the velocity of each throw. The purpose of this condition was to examine the influence of knowledge of results on task performance. The comparison strategy group was only told to "throw the ball toward the curtain" prior to each throw, while the task group were merely told to throw the ball "hard." Each participant threw a total of 60 throws during the study. The results revealed significant differences in body component levels of the participants in the cue, task-feedback, and task strategy groups compared to the comparison strategy. The cue and task-feedback strategies also led to a significant difference in ball velocity compared to the comparison strategy.

More recently, Cohen et al. (2012) studied the impact of aligned developmental feedback (ADF) on overhand throwing force in third grade students. Ninety-seven children participated in the study and were randomly assigned to an ADF group or a general feedback group. Participant's throwing force was measured. They were asked to throw a tennis ball as hard as they could at a wall that was 20 feet away. Each student received five trials. The participants developmental sequence of throwing (Roberton & Halverson, 1984) was also assessed. The ADF group were provided with either positive (praise or reinforcement) or negative (corrective) feedback. The instructional activities were consistent across both groups, as each group received 84 minutes of throwing instruction over the course of seven days. Results indicated that ADF body component scores were significantly better at post-test for the step and humerus, even though the total amount of feedback between groups did not differ. A retention test 12 days later revealed significant group differences across time for the humerus and forearm body components. The ADF learners also showed greater improvements in throwing velocity from pre- to post-intervention.

At the same time, Capio and colleagues (2013) examined the effects of training on overhand throwing by manipulating the amount of practice errors. Thirty-nine children between the ages of 4 and 11 years with intellectual disabilities (ID) participated in the study, and were allocated into an error-reduced (ER), or a more traditional error-strewn (ES) group. The intervention occurred during adapted physical education lessons and consisted of 6 lessons across a 6-week period. Participants were assessed using the TGMD-2 as well as throwing accuracy. During each lesson, the participants threw 30 beanbags at the wall as they practiced for accuracy (for a total of 120 throws). The children who were apart of the ER group threw at larger targets in order to control the amount of error, while children in the ES group threw to the smallest targets. Main effects were found for both variables, as the ER group showed improvement in form and accuracy. They also engaged in more throwing activity during free play.

In a current study by Obrusnikova and Cavalier (2017), they investigated the effect of videomodeling on the acquisition of overhand throwing in typically developing children. Using a single-subject research design, six preschool-age children from an early care center were conveniently selected. Overhand throwing was assessed using the TGMD-2 at baseline, and Roberton and Halverson's (1984) developmental sequence for throwing. Four iPad videos were created for this study, that each demonstrated the whole-part-whole technique. Videos one and three were shown at full-speed without instruction, while video two displayed the performance of the skill at a slower speed. The video included visual prompts (e.g., circles, lines, arrows) in order to guide the attention of the participant and indicate the direction of the movement. The videos also included voiceovers to highlight each component of the skill. Results indicated that the children in the VM condition improved throwing performance and skills were maintained two weeks after the conclusion of the treatment. The study also revealed gender differences in throwing competency, as boys not only had a higher performance but also showed larger performance gains in comparison to girls. Other studies conducted in controlled settings have also identified gender differences in both product and process measures (Halverson et al., 1982; Roberton et al., 1979; Thomas & French, 1985; Thomas et al., 1994). Even though the overhand throwing literature in controlled environments is extensive for young children, far less research exists on throwing in game settings.

One study by Lorson and Goodway (2008) however, did describe throwing form and gender differences prior to and following a throwing game with children between the ages of 6- and 8-years. The study examined body component levels (i.e., Roberton and Halverson's developmental sequence for throwing) demonstrated during a game at pre, post, and retention test. Changes in body component levels for each gender was also investigated at pre-, post-, and retention-test. 105 first and second grade students from six intact classes participated in this study. In order to assess in game body component throwing levels, the body component assessment for throwing in games (BCATG) was developed. Specifically, throwing form in the step, trunk, and forearm components were examined. At pretest, the students participated in a game entitled snowball. The object of the game was to throw as many balls onto the other team's side of the court. Only half of the class was allowed to throw the balls at one time (the offensive team), while the other team had to move through space to catch or knock down the balls. Each game session was videotaped, which allowed the researchers to analyze throwing component levels for each participant during gameplay. Children received 4, 30 minute sessions of throwing instruction over 4-weeks. Throwing instruction focused on both individual and guided practice, with each session focusing on a different body component. The post-test then occurred, followed by a 10-day retention test. Gender differences were found during each session, for each component. However, participants did improve on overall throwing form in similar fashion to the results found in a controlled environment.

Although the studies detailed above, have demonstrated improvements in throwing competency in children using numerous approaches, the environments in which they have occurred have all been highly constrained. Experimental designs such as this (i.e., a controlled amount of trials), limit the variability in the amount of throwing practice, and while useful, may lack external validity to physical education settings where there can be inconsistencies in the number of practice trials between different students. In order to gain that variability in throwing practice, a climate that is focused on skill development is desirable. Due to the autonomous nature of mastery motivational climates, it appears to be a suitable vehicle to examine overhand throwing given that the persistence of throwing by the children will be exclusively based on intrinsic motivation. The following section will describe the theoretical underpinnings of mastery climates, identify key components of the climate, and the current literature investigating the relationship between the motivational climate and FMS are described.

Mastery Motivational Climates

Mastery-motivation. White (1959) proposed that young children have an innate desire and intrinsic motivation to engage with their environment. This engagement allows the individual to develop competence and ultimately leads to feelings of self-efficacy, or self-worth. Moreover, White (1959) adds that exploratory behaviors that "… show direction, selectivity, and persistence with the environment" (p.329), are how competence is obtained. This curiosity is further driven by feelings of pleasure from successfully learning or mastering a skill. So, it could be said that children are mastery motivated from birth.

Moreover, mastery motivation is an intrinsic psychological force that stimulates young children to master challenging skills or tasks based on intrinsic interests and occurs without the need for extrinsic rewards (Morgan, Harmon, & Maslin-Cole, 1990; Morgan, MacTurk, & Hrncir, 1995). In order to define mastery motivation, Hauser-Cram (1998) posits that there are three components that are imperative to understand: (a) the child has an innate, intrinsic drive to master tasks without direction from an adult; (b) mastery motivated children are persistent at mastering challenging tasks; and (c) children select moderately challenging tasks to master without guidance. So not only are young children naturally motivated to master tasks, but they actually prefer some difficulty and they give maximal effort while engaging in these difficult tasks.

In the beginning, mastery motivation only referred to the mastery of inanimate objects. However, research has since identified other forms of mastery motivation. Gross motor mastery motivation describes children's intrinsic desire to master play experiences and fundamental gross motor skills (Morgan et al., 1993) and is ultimately responsible for young children learning to move (i.e., crawl, walk, and run). It is essential to foster the early development of mastery motivation, as Morgan & Yang (1995) have identified mastery motivation as the precursor for future achievement motivation. Moreover, the external standards of performance become increasingly more influential on young children as mastery motivation develops (Barret & Morgan, 1995; Harter 1978). Several studies have identified the impact of the behaviors (i.e., positive or negative affective interactions) of primary caregivers on a child's mastery motivation development (Hauser-Cram 1998; Hauser-Cram & Shonkoff, 1995). These studies highlight the importance for adults to encourage children attempt to master tasks they are interested in, as adult intrusive behaviors have been found to interrupt mastery attempts and decrease mastery motivation. On the other hand, Hauser-Cram & Shonkoff (1995) described positive affective and emotional responses by the primary caregiver as crucial in developing children's mastery motivation. Similarly, Harter (1981) & Hauser-Cram (1998) identified behaviors of caregivers that increase a child's interest in mastering tasks (i.e., gross motor skills). According to them, a caregiver who is autonomy-supportive: (a) models mastery motivation; (b) creates a stimulating environment; and (c) provides positive and corrective feedback to keep the child engaged in challenging tasks. Therefore, it is important for pre-school teachers to support mastery motivated learning in order to nurture the intrinsic drive that children have to learn. The Achievement goal theory provides a framework to explain how teachers can create a motivational learning climate that encourages mastery motivation for children.

Achievement goal theory. According to the achievement goal theory, individuals participate in achievement contexts (i.e., sports and academics) for the primary purpose of demonstrating competence or ability (Nicholls, 1989). Nicholls (1984) also proposes that within achievement contexts there are two achievement goal states (i.e., ego and task involvement) that influence how individuals interpret their ability and define success.

Ego-involvement is based on an individual's ability to distinguish between causal factors that are related to successful or unsuccessful performances (i.e., ability, luck, or effort); social and normative referenced comparisons; and a belief that success is a direct outcome of ability. An individual who is ego-involved, has a goal of outperforming others as a successful outcome (Nicholls, 1984). In addition, an ego-involved individual believes that exerting lots of effort is the sign of a lack of ability. Thus, they view participation as a chance to display high ability while exerting minimal effort in comparison to others.

On the other hand, task-involvement is based on performing a task with an undifferentiated conception of ability, whereby they use self-referenced criteria (i.e., effort, improvement, and mastering tasks) as a means of defining success. Causal factors related to success are based on effort, and individuals seek improvement in reference to their own previous personal performance. To learn is to demonstrate ability, and task mastery is the goal to achieve (Nicholls, 1984). An individual who is task-involved typically exerts lots of effort when mastering skills for the sake of learning. In this manner, success is achieved when a task is mastered and maximum effort is exerted.

Goal states, goal Orientations, and motivational climate. Nichols (1984, 1989) also suggests ego- and task-involved goals are engrained in an individual's dispositional goal orientations. Goal states are determined based on the interplay between their dispositional goal orientation and their perception of that particular environment. Moreover, dispositions are not stable personality traits, but are tendencies that are largely impacted by environmental cues. Based on the situation as well as the individual's perception of the cues within the achievement context, the dispositional goal orientations of an individual may differ. For example, an individual in a mastery-oriented climate could display high task orientation but low ego orientation. On the other hand, that same individual could exhibit low task, but high ego orientation.

Further, Nicholls (1984; 1989) labels dispositional goal orientations in terms of ego- and task-oriented goals. An ego-oriented individual will avoid challenging tasks due to their belief that intrinsic factors (i.e., ability) are what lead to success, along with their desire to demonstrate high ability while exerting little effort (Dweck & Leggett, 1988). They will also engage in tasks in which they are confident that they can be successful in (Wigfield, Eccles, & Rodriguiz, 1998). These individuals are not persistent when facing failure, as failure indicates a lack of ability in comparison to those who are successful, and they will likely avoid engaging in problem solving strategies and hesitate to seek help from others (Ames 1992a, 1992b). In comparison, individuals who are task-oriented tend to enjoy the actual process of learning. They attribute learning to motivation and working hard (Biddle, Akande, Vlachopoulos, & Fox, 1996; Duda, Fox, Biddle, & Armstrong, 1992; Duda & White, 1992; Fox, Goudas, Biddle, Duda, & Armstrong, 1994;

Spray, Biddle, & Fox, 1999). For these individuals, learning would be considered a successful outcome which demonstrates mastery. When facing adversity, they will likely persist, and they attribute their learning (i.e., mastering a skill) to effort and ability. This learning process also allows them to experience positive affect (i.e., joy and pleasure) in response to their achievement. Task-oriented learners make self-referenced assessments about their ability based on past experiences, will engage in self-instructional strategies that promote learning, and spend substantial time engaging in behavior. Lastly, they will seek help and use resources and instructional support when facing challenges in order to learn to self-regulate their own learning (Solmon & Boone, 1993).

Not only have researchers identified a variety of characteristics that differentiate ego- versus –task-oriented individual (Ames, 1992a, 1992b; Ames & Archer,1988; Dweck & Leggett, 1988; Nicholls, 1984,1989), but studies have also focused on characterizing the situational cues that interact with an individual's dispositional goal orientation to determine his/her goal state. These studies suggest that not only does an individual's disposition contribute to the adopted goal state, but the task- and ego-involvement are also influenced by situational cues (i.e., mastery- or performance-oriented climate) that operate within the achievement context (Ames & Archer,1988; Nicholls, 1984,1989). The probability of adopting a specific goal state and demonstrating a certain behavior are determined by dispositions, while the individual's perception of the motivational climate (i.e., environmental or situational cues) are malleable and influence behavior (Dweck & Leggett, 1988; Nicholls, 1989; Treasure & Roberts, 2001). An individual's disposition is less likely to predict the goal involvement in achievement contexts that encourage either mastery- or ego-oriented motivational climates, but rather the motivational cues that operate within the context will determine the goal involvement and subsequent behavior of the individual. According to Dweck & Leggett (1988), an individual's dispositional tendency more accurately predicts the goal involvement than the situational cues in achievement contexts that demonstrate vague or weak situational cues. On the other hand, when they situational cues heavily favor either performance- or mastery-oriented motivational climates, an individual's disposition is less likely to be able to predict goal-involvement. Instead, it is the motivational cues that operate within the situation that determine the goal-involvement and the resulting behavior off the individual. Moreover, strong mastery-oriented climates should be implemented in achievement contexts in order to increase the chances of adaptive patterns of achievement behavior (i.e., task involvement).

Ames & Archer (1987, 1988) examined the differences between performance- and mastery-oriented motivational climates and identified the salience of the performance and mastery cues by an individual in a learning situation impact the goal orientation, and goal state, the individual undertakes. Accordingly, Ames & Archer (1987,1988) developed strategies for identifying and investigating crucial environmental characteristics and instructional cues that lead to an individual adopting either performance- and/or mastery-oriented achievement goals. These key environmental constructs and cues were conceptualized by Ames (1992a, 1992b) and are based on Epstein's (1988,1989) six dimensional TARGET structures. The TARGET structures are described in more detail in the following section.

TARGET structures. The TARGET acronym stands for Task, Authority, Recognition, Grouping, Evaluation, and Time. These constructs were originally developed in the classroom to assist teachers in organizing their classroom instruction in a manner that positively influences students' learning and motivation (Epstein, 1988,1989). Ames (1992a, 1992b) later described these components in terms of both performance- and mastery-oriented climates. She also designed strategies incorporate these TARGET structures in classroom settings. Moreover, these TARGET structures are regularly used by both practitioners and researchers to identify important environmental factors and instructional cues that effect and individual's achievement goal state. According to Ames (1992a), an individual's motivation can be positively influenced by organizing these constructs in a manner that reflects a mastery-oriented climate and implementing them in a variety of settings. A description of each of the TARGET structure follows.

The *task* component of the TARGET structure refers to the type of task and task options that are available within a learning environment. This includes the content and sequence of the curriculum, the design of the instructional activities (i.e., homework and classroom work), the difficulty of the task, and the materials required to complete a task. Providing a variety of task structures offers students a wide range of options from which to choose to engage in the activity in which they prefer. Raffini (1993) also contends that instructors need to be cognizant of the skill level of each student in order to provide a variety of challenging tasks. In turn, this will foster the mastery goals of all learners, irrespective of skill level.

The *authority* construct of the TARGET structure stresses the importance of teachers and students working collaboratively in the decision-making process. Specifically, the distribution of authority and student autonomy within the learning environment is encouraged. As a result, the teachers and students share the responsibility for making choices, creating and enforcing rules, monitoring progress, giving directions, creating and providing rewards, and evaluating success (Epstein, 1988). It is important to note that the teacher remains the primary authority, but the students' commitment to learning and motivation toward mastery goals is enriched in such a high autonomy learning environment. In this manner, the teacher acts as a facilitator of learning instead of as an agent of control.

The *recognition* element within the TARGET structure refers to the feedback, rewards, and reinforcement that are given within the learning environment. Students are recognized for their effort and mastery-focused accomplishments that are based on their past and current achievements and skill level, respectively. Avoiding social comparisons and emphasizing personal achievements, helps teachers encourage students' motivation towards skill mastery (Ames, 1992a; Epstein, 1988, 1989).

The *grouping* component of the TARGET structure determines whether, how, and why students who are alike or different (i.e., based on gender, ability, race, goals, interest) are brought together or kept apart for instruction, play, and physical activity. Researchers, namely Epstein (1988) and Ames (1992) posit that a teacher can boost students' motivation toward task mastery by providing flexible, heterogeneous grouping arrangements and allowing students to group themselves in the learning environment.

The *evaluation* construct of the TARGET structure refers to the implementation of a system for assessing student progress. The learner must be aware of and understand their progress in a climate that promotes the adoption of a task orientation. Evaluation criteria should incorporate moderately challenging standards, include fair and concise procedures for monitoring progress, and provide frequent and meaningful information about progress. An effective evaluation structure fosters student motivation toward mastery, as students (young children in particular) do not understand their own level of effort, skill, or means of improving (Nicholls, 1984). In a mastery climate, instructors should evaluate based on individual progress and improvement and mastery; provide individualize, private, meaningful and evaluative feedback; involve students in the evaluation process; and promote successful opportunities for students.

Finally, the *time* element within the TARGET structure refers to the time constraints placed on learning, such as the appropriateness of the workload, the pace of instruction, and the amount of time allocated to task completion (Ames, 1992b). Instructors should incorporate a flexible schedule for completing assignments and tasks to respect each student's pace of learning (Ames, 1992a; Epstein, 1989). This allows students sufficient time to improve skill level and create work and practice schedules that promote the adoption of mastery motivation, regardless of their individual skill level.

In summary, the TARGET structures provide a conceptual framework that allows instructors to create mastery motivational climates to deliver content and curriculum. Instructors can promote task-oriented learners and the adoption of mastery motivation by valuing the learning process, including self-references standards of success, and providing opportunities for self-regulated learning. The learning environment instructors create are critical to be aware of as they influence the manner in which children learn, which in turn influence a number of cognitive, affective, and behavioral variables. The following section will highlight research conducted on mastery motivational climates.

Mastery motivational climate intervention outcomes. There is an extensive amount of achievement goal theory research focusing on the motivational climate. These studies have taken place in a variety of settings (i.e., academia, sport, and physical education), and with numerous populations (i.e., children, adolescents, and young adults). Collectively, these studies suggest that a mastery-oriented climate plays an essential role in enhancing the achievement behavior of all learners (Ames, 1992a, 1992b; Epstein, 1988, 1989). Moreover, students who perceive their educational learning environment to be both highly autonomous and mastery-oriented have reported the following outcomes:

In academia.

- Increases in perceived competence (Harter, 1978; Harter, Whitesell, & Kowalski, 1992; perceived academic efficacy, and general well-being (Kaplan & Maehr, 1999);
- an improvement in intrinsic motivation and sense of self-reliance (Maehr, 1983, 1984);
- considerably larger levels of persistence during learning (Ames & Archer, 1988; Butler, 1987);
- a common use of effective learning strategies, self-monitoring of thoughts, self-instruction, and a preference for challenging tasks (Ames, 1984a, 1984b; Ames & Archer, 1988);
- a positive attitude towards learning and effort (Ames, 1992b; Corno & Rohrkemper, 1985; Nicholls, 1989); and
- a belief that hard work and cooperation (Ames,1984a, 1984b; Ames & Archer, 1988) leads to success (i.e., learning);

In sport and physical education.

- Increases in physical activity engagement in comparison to students who perceive a low autonomy (Parish & Treasure, 2003) or free play experience (i.e., a high autonomy climate without the TARGET structures) (Parish, St. Onge, Rudisill, Weimar, & Wall, 2005; Parish & Rudisill, 2014; Parish, Rudisill, & St. Onge, 2007; Wadsworth, Robinson, Rudisill, Gell, 2013; Wall, Rudisill, & Gladden, 2009);
- an intrinsic interest in physical education (Cury et al., 1996);

- intentions to be physically active in the future (Ntoumanis & Biddle, 1999b; Parish & Treasure, 2003);
- less time spent in management activities by the instructor, and more time spent in fitness activities (Logan, Robinson, Webster, & Rudisill, 2015);
- greater on task-behaviors and engagement (Hastie, Rudisill, & Boyd, 2016);
- an increase in moderate-to-vigorous physical activity and less time spent in sedentary activities (Wadsworth, Rudisill, Hastie, Boyd, & Rodriguez-Hernandez, 2014);
- a rise in adherence to activity (Yoo, 1999);
- improvements in perceived physical competence (Barkoukis, Koidou, & Tsorbatzoudis, 2010; Robinson, Rudisill, & Goodway, 2009; Rudisill, 1989a, 1989b; Theeboom, DeKnop, & Weiss, 1995; Valentini & Rudisill, 2004b);
- greater perceived social competence, scholastic competence, and perceived sport competence (Newsham, 1989) and perceived ability (Burton, 1989);
- an increase in exerted effort and a decrease in levels of performance worry in comparison to engaging in less student-driven climates (Seifriz, Duda, & Chi, 1992; Walling, Duda, & Chi, 1993);
- considerably larger levels of persistence during learning (Rudisill, 1991), enjoyment (Goudas, 1998; Kavussanu & Roberts, 1996; Lloyd & Fox, 1992; Ntoumanis & Biddle, 1999a, 1999b; Ommundsen, Roberts, & Kavussanu, 1998; Theeboom et al., 1995; Treasure & Roberts, 2001), and satisfaction (Goudas, 1998; Theeboom et al., 1995; Treasure & Roberts, 2001) in comparison to engaging in less student-driven climates;
- a preference of challenging tasks (Treasure & Roberts, 2001);

- a greater focus on learning and effort (Carpenter & Morgan, 2000; Papaioannou & Kouli, 1999);
- a positive attitude towards learning and effort (Treasure, 1997);
- encouraging children to employ metacognitive strategies (Theodosiou, Mantis, & Papaioannou, 2008);
- positive affect (i.e., satisfaction, enjoyment, less boredom, attitude towards the class), high perceived competence and intrinsic motivation, and attributing success to effort and ability (Carpenter & Morgan, 2000; Dunn, 2000; Kavussanu & Roberts, 1996; Ntoumanis & Biddle, 1999b; Treasure, 1997; Yoo, 2003);
- a belief that learning is achieved through intrinsic interest, effort (Carpenter & Morgan, 2000; Treasure & Roberts, 2001), hard work, and cooperation (Seifriz et al., 1992; Treasure, 1997; Walling & Duda, 1995; Walling et al., 1993); and
- improvements in fundamental motor skills (Hastie, Rudisill, & Wadsworth, 2013; Martin, Rudisill, & Hastie, 2009; Robinson, 2011; Robinson & Goodway, 2009; Theeboom et al., 1995; Valentini & Rudisill, 2004a, 2004b; Wall, Rudisill, Parish, & Goodway, 2004; Valentini, Pierosan, Rudisill, & Hastie, 2017).

Early childhood fundamental motor skill improvements. The research on achievement goal theory, specifically regarding motivational climate and young children, has substantially grown recently. These studies have focused on the effectiveness of mastery-oriented (i.e., mastery motivational climates) interventions in improving fundamental motor skill development in young children (Hastie et al., 2013; Martin et al., 2009; Robinson, 2011; Robinson & Goodway, 2009; Theeboom et al., 1995; Valentini & Rudisill, 2004a, 2004b; Valentini et al., 2017).

Originally, Theeboom et al (1995) investigated the influence of a mastery-oriented (i.e., mastery motivational) intervention and a performance-oriented (i.e., traditional) intervention on the motor skill development of children. One hundred and nineteen children between the ages of 8 and 12 years participated in the study and were randomly assigned to either condition (mastery or performance). During the first three weeks of the summer sports program, the mastery group received instruction on the wushu, while the traditional group received instruction on wrestling. During the second half of camp (i.e., weeks 4 -6), the instruction for each group was reversed. Results indicated that children in the mastery group exhibited better motor skills (as measured by the level of wushu skill) than those in the performance group.

A later study by Valentini and Rudisill (2004b) examined the influence of a mastery-oriented (i.e., mastery motivational) intervention and a performance-oriented (i.e., teacher centered, direct instruction) intervention on the fundamental motor skill (measured by the TGMD) performance of children with developmental delays. Participants included 60 kindergarten children between ages 5 and 6 who were randomly assigned to a mastery-oriented, performance-oriented, or control group. Both intervention groups participated in 24, 35-min sessions over a 12-week period, while the control group received no intervention. Results revealed that the children in the mastery motivational group performed better locomotor and object control skills compared to students in the performance-oriented and control group.

Further, Valentini and Rudisill (2004b) sought to determine the lasting effects of the intervention. Accordingly, they eliminated the performance-oriented condition in part one, and added a retention test to investigate participant's fundamental motor skill performance six months after the conclusion of the intervention. Sixty-seven kindergarten children who were developmentally-delayed were assigned to either a mastery motivational (n =38) or a low autonomy, performance-oriented (*n* = 29) group. After a 12-week intervention (i.e., 24 sessions, 35 min per session), both groups showed improvements in locomotor and object control skills, but the mastery motivational group's improvements were significantly better than the children in the performance-oriented group. Participants in the mastery motivational group also maintained their skill level six months after the intervention, while the control group showed a significant decrease in skill performance.

Thereafter, Valentini and Rudisill (2004a) additionally studied the impact of a mastery motivational climate on the fundamental motor skill development of kindergarten children with and without disabilities, similar to their previous research design, participants were randomly assigned to either a mastery motivational intervention group or a control group. These two groups were then divided into four subgroups according to ability (i.e., mastery motivational with disabilities, mastery motivational without disabilities, control with disabilities, control without disabilities). Participants of both mastery motivational climate groups (i.e., with and without disability) showed significant motor skill improvements from pre- to post-intervention after a 12-week intervention, while there were no differences reported for either control group condition.

Later, a study by Martin et al. (2009) investigated the impact of 6-week mastery motivational climate intervention on children's fundamental motor skills in a naturalistic setting in comparison to a low autonomy climate physical education intervention. Sixty-four kindergarten children participated in 30, 30-min sessions (for a total of 900 minutes). A quasi-experimental design was implemented due to the lack of random assignment. Children's fundamental motor skills were assessed three times using the TGMD-2 (i.e., at the beginning of the year, six weeks after school began, and following the intervention). Results revealed a significant improvement in fundamental motor skills for the mastery motivational climate intervention group, but not the low autonomy group.

At the same time, Robinson & Goodway (2009) examined the effects two 9-week instructional climates (i.e., a low autonomy and mastery motivational climate intervention) on the fundamental motor skills (i.e., object control skills) of preschoolers who were at-risk for developmental-delays and poor health. One hundred and seventeen participants were randomly assigned to either a low autonomy (*n* = 78) or mastery motivational climate intervention group (*n* = 39). Participants were assessed using the object control subscale of the TGMD-2 at pretest, posttest, and nine weeks after the intervention. The results indicated that the children in the mastery motivational climate group improved their object control skills and maintained their skills at retention test.

Thereafter, Robinson (2011) expanded her previous work and sought to determine the effects of a mastery motivational climate intervention on object control skills of preschool children who served as the control group in the previous study (Robinson & Goodway, 2009). Forty preschool children participated in a 9-week intervention where they received 18, 30-min motor skill sessions. Children were assessed using the TGMD-2 before and after the intervention. The results indicated that the participants showed a significant improvement in object control skills following the intervention.

Based on the results of these studies, majority of the more recent research on mastery motivational climate interventions have begun to examine other dependent variables (i.e., physical activity and engagement) as the findings consistently suggest that mastery motivational climates do in fact lead to improved fundamental motor skill learning in young children. Although a recent study by Valentini and colleagues (2017) examined the effects of mastery motivational climate on the fundamental motor skills (TGMD-2) on 64 Brazilian children both with and without disability. Participants engaged in a mastery motivational climate for 14 weeks (28 one hour sessions twice a week). Posttest results indicated a significant improvement in both object control and locomotor skills.

Although the studies detailed above support that mastery motivational climate interventions result in significantly better fundamental motor skill development, little information is known about the actual behaviors of young children during the intervention. That is, each intervention has investigated the "product" of mastery motivational climates, but little attention has paid attention to the "process." Accordingly, a systematic review on mastery motivational climate interventions in physical education settings conducted by Hastie et al., (2013), suggested that researchers should more closely examine student engagement within mastery motivational climates to understand what is influencing these positive fundamental motor skill learning outcomes from these interventions. To date, only two studies have focused on the behavioral engagement of young children who participate in mastery motivational programs. Hastie and colleagues (2016) tracked the engagement behavior of thirteen preschool children who participated in a bi-weekly mastery motivational climate intervention for 30 min each session. The results indicated that a significant difference in children's lesson engagement across the school year and within the lessons. Near the end of the intervention the children were able to stay engaged for nearly 80 percent of the lesson time. The preliminary findings of this study provide insight into the behavioral engagement of preschool children in mastery motivational climate settings. To understand more about what specific behaviors impact the "process" of fundamental motor skill development of children, further research is imperative.

Summary

In conclusion, it is imperative for young children to develop fundamental motor skills (i.e., throwing) at an early age as these skills have been associated with a number of health outcomes. Early exposure to motor skill interventions can accelerate the development of these motor skills. Moreover, young children are naturally motivated to master new and challenging tasks. Consequently, when presented with an environment focused on mastery and skill learning, children are motivated to achieve. Achievement goal theory provides a framework for explaining an individual's achievement motivation. There is sufficient evidence of research conducted with younger children that has examined the relationship between the motivational climate and fundamental motor skill development. Although these studies have contributed significantly to the field of motor development, they have not identified a relationship between the impact of specific behavioral engagement (i.e., throwing practice) during a mastery motivational climate and changes in specific skill competence (i.e., throwing).

The current study aims to determine the influence of throwing practice (i.e., time, visits, trials) during a mastery motivational climate intervention on different aspects of throwing competency (i.e., TGMD-3, Roberton and Halverson's developmental sequence for throwing, throwing velocity) of preschool-age children. Because fundamental motor skill development is essential for engaging in later physical activity, it is important to identify how much intrinsically motivating practice young children need (in a non-controlled environment) in order to experience skill improvement. A mastery motivational climate may be an effective means by which to gain variability in the amount of throwing practice between individuals (as opposed to a set number of throws for participants). This study aims to contribute to the field of motor development by providing a richer picture of the impact of practice on the skill development of preschool aged children when exposed to a mastery motivational climate. In the future, this study's findings may lead to the identification of a specific amount of practice that is necessary to enhance overhand throwing in young children, which has been found to be related to overall fitness in young adults.

Chapter III

Methods

The purpose of this study was to determine the influence of guided throwing practice volume (e.g., the amount of time spent practicing throwing, number of visits to the throwing station, and the number of throwing trials during practice time) during a mastery motivational climate intervention on throwing competency (TGMD-3, Roberton and Halverson's developmental sequence for throwing, throwing velocity) in preschool-aged children. This chapter provides an overview of the research design and variables of interest. Participant information, the context of the study, characteristics of the intervention, research procedures, and instrumentation are included. Finally, data analyses and statistical procedures are presented.

Human Subjects Approval

Prior to recruitment for this study, a research protocol review form was submitted to the Auburn University Institutional Review Board for Research Involving Human Subjects (IRB). IRB Approval (see Appendix A) was granted under the following protocol number: 06-626 EP 0701.

Research Design

The study used two separate research designs. A within-subject design was used to determine if children demonstrated improvements in throwing competency following participation in a mastery motivational climate intervention. A correlational design was then employed to determine if there was a relationship between the change in throwing proficiency and throwing velocity, and the volume of throwing practice (i.e., the amount of time spent practicing throwing, number of visits to the throwing station, and the number of throwing trials during practice time) during a mastery motivational climate intervention.

Participants and Setting

The participants in this study were drawn from a potential pool of 68 preschool age children between the ages of 3- and 5- years old from 4 classes at a Head Start center in the Southeastern United States. The head start is embedded with the Alabama Council on Human Relations, Inc. (ACHR) Child Development Program that provides a variety of services for children and their families living in Lee and Russell Counties.

Per ACHR guidelines, their Head Start center-based services serve children ages 3 to 5 years in families with low income. These programs are designed to enhance the educational, nutritional, health, and social services needs of children and families (Burns, 2017). The Head Start center serves mostly African American children from the local community who are environmentally at-risk for developmental delay and poor health.

A positive working relationship was established with this facility. Each classroom had up to 18 children being taught by one full-time teacher and one part-time teacher's aide, which are in accordance with the State of Alabama, Department of Human Resources (2006) teacher-to-student ratio requirements (i.e., 1:11 for 2.5- to 4-years-olds, 1:18 for children 4 years old up to lawful school age) for preschool age children. The children attended the Head Start center from 8:30 a.m. until 1:00 p.m. According to national day care guidelines, the children are required to spend at least 40 minutes outside on the playground every day.

The intervention took place on the day care's playground bi-weekly (Tuesday and Thursday) for 30 minutes during this time. There were two separate sessions of the intervention where two classes were on the playground at a time (i.e., classroom C and O from 9:00 a.m. – 9:30 a.m., followed by classroom B and J from 9:45 a.m. – 10:15 a.m.). There was a maximum of 36 children (i.e., 18 per class if there are no absences) participating in the intervention at any given time. The playground is located on the west wing of the center and included a sandbox with swings (that was wrapped up during this time), an additional sandbox, and playground equipment that includes a slide and monkey bars. These areas were off limits to the children on the days of the intervention.

The teacher delivering the mastery motivational climate intervention was a faculty member from the university. She is a certified physical education teacher with extensive experience incorporating mastery motivational climates into her instructional delivery. She has also conducted numerous mastery motivational climate research studies with young children over the past 20 years. Additionally, the teachers from each classroom were on the playground, as well as the primary investigator of this study (who did not leave the throwing station) and six other trained research assistants throughout the playground.

Procedures

After receiving approval from the University's Institutional Review Board for Research Involving Human Subjects and prior to the start of data collection, all children enrolled in classrooms B, C, J, and O were recruited to participate in a mastery motivational climate intervention that emphasized motor skill development. A letter (Appendix B) and informed consent (Appendix C) forms were sent home to the legal guardian (s) of each child requesting permission for their child to participate in the study. Two weeks were provided for parents to return the informed consent.

Upon receiving verbal assent from each child, baseline data collection was conducted. A week prior to the start of the intervention, and a week after the completion of the study, three sets of data were collected from the entire population on the center's playground: (a) overhand throwing proficiency per the third edition of the Test of Gross and Motor Development (TGMD-

3), (b) overhand throwing technique per Roberton and Halverson's developmental sequence for throwing (1984), and (c) throwing velocity (as measured by a Stalker Pro II radar gun). During the program, three further measures were recorded for each student who spent time at the throwing station: (a) the total number of visits to the throwing station, (b) the total number of practice trials, and (c) the total time spent at the station. All sessions of the throwing station were videotaped using a tripod mounted camera which captured all of the children's throwing engagement during the lessons. The intervention is described in more detail in the next section.

Mastery Motivational Climate Intervention

Ames and Archer (1987, 1988) developed strategies for identifying key environmental characteristics and instructional cues that the lead to the adoption of mastery-oriented goals and thus the implementation of a mastery motivational climate. These key characteristics and instructional cues were conceptualized by Ames (1992a, 1992b), and are based on Epstein's (1988, 1989) six dimensional TARGET structures. The TARGET acronym stands for Task, Authority, Recognition, Grouping, Evaluation, and Time. A description of each TARGET structure for mastery motivational climates is provided below.

The task structure refers to the type of task and the task options designed within a learning environment. This provides students with a large range of options to choose from. The authority structure suggests that students and teachers work together in the instructional design making process. The recognition structure refers to implementation of feedback and reinforcements within the environment. Students are praised for their effort. The grouping structure allows students to group themselves and play with whomever they choose to. The evaluation structure refers to the implementation of a system for evaluating student progress. Evaluations are based on individual progress, improvement, and mastery, but most importantly are done privately and are individualized. Lastly, and most importantly for this study, the time structure allows students to decide how long they engage in a task. Thus, children were allowed to have complete autonomy over which stations they participated in, how long they stayed at these particular stations, as well as who they played with (if anyone) while visiting these stations.

There were six to eight activity stations designed for each lesson plan to emphasize engagement in FMS. The stations were designed based on the skills that exist on the fundamental motor skill assessment and included locomotor skills (i.e., run, gallop, skip, hop, horizontal jump, and slide) and object control/ball skills (e.g., dribble, catch, kick, one-hand forehand strike, two-hand strike, underhand throw, and overhand throw). Activities were designed to allow both the lowest and highest skilled children to be successful. Other stations (e.g., bouncing on hoppy balls) were also included as they promoted foundational abilities that are necessary to perform FMS, such as leg strength and balance. Within this study, the focus was explicitly on the children's participation at the throwing station only. Accordingly, there was a throwing station designed and implemented during every session.

Throwing station design

The throwing station was designed to allow the children to throw for distance, accuracy, and speed. This section provides sample activities that were incorporated on each of the different lessons that emphasized different throwing behaviors for children. Different types of throwing implements (i.e., mini footballs, yarn balls, plastic all-balls, tennis balls, slo-mo balls, spike knobby balls, puffer balls) were available during every lesson.

On days where throwing for distance was emphasized, children participated in a task called 'throwing for the stars.' In this task, children were instructed to stand on poly spots (in different locations within the station) and threw towards different colored stars. The stars were also indicated with cones that were the same color. The objective was to throw the ball as far as possible in order to reach the furthest colored star. Children could also make the task more challenging by standing on different poly spots that were located further away, while still trying to throw beyond the furthest star. In this manner, all children could allow themselves to experience varying levels of success.

During other lessons, the focus for children was geared towards throwing for accuracy. Children again threw from different poly spots (i.e., closer and further away), through hoops (e.g., a pole with a hula hoop connected that is inserted into a cone) that were located either closer to or further away from the children. These hoops stood at different heights, with some of the hoops being pretty low to the ground and other hoops that were much taller than the children.

Finally, on days where the goal was for children to throw for speed, the research team created two separate artificial 'walls', using two portable volleyball poles with a 12' x 16' tarpaulin stretched between the poles. Children were instructed to throw "as hard as they could" at the wall from different distances (i.e., different poly spots) with different implements. Two separate walls were set up due to the narrow width of the tarp to ensure that children did not have to throw for accuracy.

Towards the end of the intervention, these activities were combined in a variety of ways so that children could throw for either distance, accuracy, and velocity simultaneously. (See Appendix D for example throwing station designs.)

Throwing instruction and feedback

While the amount of instruction and feedback given to each participant varied on an individual basis, all participants received age and skill appropriate instruction and feedback. The following cues were reinforced and emphasized throughout the duration of the intervention. These cues were appropriate for the age and the skill level of the participants in this study:

a) Reach your arm back.
b) Step with the opposite foot.
c) Throw as hard as you can.

Measures

TGMD-3 throwing

The overhand throwing protocol of the test of Gross Motor Development 3 (Ulrich, 2013) was administered, with all children having one practice and two formal trials following a demonstration by the researcher. Each participant stood 20 feet (6.1 meters) away from the wall for each throw. All trials were videotaped.

According to the TGMD-3 the throwing criteria is evaluated by four performance criteria (See Table 3.1). A score of zero is given for each criterion that is not performed during a trial, and a score of one is given if a criterion is performed during each trial. The minimum score a participant can receive is 0, while the maximum score for each child is 8, respectively. The raw scores for throwing were used given the interest in improvement and not comparison to other children. It should be noted that there are no normative data for specific skills in the TGMD-3 (only the locomotor and ball skills subtest), which precludes pre-post comparison of anything but raw scores for overhand throwing. One researcher scored each of the TGMD-3 throwing trials. While the test-retest reliability coefficients for the most updated version of this assessment are not yet available, Ulrich (2000) reported mean test-retest reliability coefficients at .93 for object control items and inter-rater reliability coefficients at .98.

Inter-rater reliability. Inter-rater reliability was established between the primary researcher who scored all TGMD-3 throwing assessments and a trained expert. To ensure the reliability of the TGMD-3 data, the researcher was trained for about 20 hours throughout multiple meetings in which they viewed and analyzed video clips of fundamental motor skills that were not a part of the current study. The researcher was considered adequately reliable when they reached a 90% (intraclass correlation coefficient > 0.90) accurate standard with respect to both intra- and interobserver reliability. This was calculated by means of the intraclass correlation coefficient and percent agreement ((agreement/disagreement) * 100) achieved following multiple video assessments of children performing several overhand throwing skills separated by two weeks. Reliability of the pre-test and post-test data was measured through inter-rater evaluation of the researcher. In this evaluation, the researcher analyzed more than 15% of children's overhand throwing.

Table 3.1

Overhand Throwing Performance Criteria for the Test of Gross and Motor Development-3

Performance Criteria	Description
1	Windup is initiated with a downward movement of hand and arm.
2	Rotates the hip and shoulder to a point where the non-throwing side faces the wall.
3	Steps with the foot opposite the throwing hand toward the wall.
4	Throwing hand follows through after the ball release, across the body, toward the hip of the non-throwing side.

Note. From *Test of Gross Motor Development- Third Edition (TGMD-3).* By Dale Ulrich.

Developmental sequence for throwing. Changes in overarm throwing technique across pre-post-test were assessed using Roberton and Halverson's five-component developmental sequence table (Roberton, 1984, p.74, see Appendix E). Presented by Roberton and Halverson (1984), the model component analyzes the following five components for overarm throw: trunk action (three developmental steps), foot action (four developmental steps), arm backswing (four developmental steps), humerus action (three developmental steps), and forearm action (three developmental steps). Validation of the trunk and arm sequences, with the exception of the arm backswing have been empirically supported (Halverson et al., 1982; Roberton, 1977, 1978a; Roberton & DiRocco, 1981; Roberton & Langendorfer, 1980), while the other three components were hypothesized by Roberton (1984) and Langendorfer (1982).

The steps have been divided into segmental movement components and are shown below in Table 3.2. An accumulative developmental sequence score is calculated by adding the developmental steps of each component. The minimum score a participant can receive is 5, while the maximum score for each child is 17, respectively. The highest modal score between the two trials were used for data analyses. One researcher scored all developmental sequencing using the same videos from the TGMD-3 throwing assessment (side view) as well as an additional video that was recorded from the posterior view. These two videos combined allowed the researcher to capture and analyze each movement component.

Inter-rater reliability. Inter-rater reliability was established between the primary researcher who scored all developmental sequence for throwing assessments and a trained expert. To ensure the reliability of the developmental sequence for throwing data, the researcher was trained for at least 20 hours throughout multiple meetings in which they viewed and analyzed the developmental sequencing of video clips of overhand throwing not a part of the current study. The researcher was considered adequately reliable when they achieved a 90% (intraclass correlation coefficient > 0.90) accurate standard with respect to both intra- and interobserver reliability. This was calculated by means of the intraclass correlation coefficient and percent agreement ((agreement/disagreement) * 100) achieved following multiple video assessments of children of different levels performing overhand throwing skills separated by two weeks. Reliability of the pre-test and post-test data was measured through inter-rater evaluation of the researcher. In this evaluation, the researcher analyzed more than 15% of children's overhand throwing.

Table 3.2

Roberton and Halverson's Developmental Sequence for Throwing

Stage	Action
	Trunk action in throwing and striking for force
Step 1	No trunk action or forward or backward movements. Only the arm is active in force production. Sometimes the forward thrust of the arm pulls the trunk into a passive left rotation (assuming a right-handed throw), but no twist-up precedes that action. If trunk action occurs, it accompanies the forward thrust of the arm by flexing forward at the hips. Preparatory extension sometimes precedes forward hip flexion.
Step 2	Upper trunk rotation or total trunk ("block") rotation. The spine and pelvis rotate away from the intended line of flight and then simultaneously begin forward rotation, acting as a unit, for "block." Occasionally, only the upper spine twists away, then toward the direction of force. The pelvis, then, remains fixed, facing the line of flight, or joins the rotary movement after forward spinal rotation has begun.
Step 3	Differentiated rotation. The pelvis precedes the upper spine in initiating forward rotation. The child twists away from the intended line of ball flight and then begins forward rotation with the pelvis while the upper spine it still twisting away.
	Backswing, humerus, and forearm action in the overarm throw for force *Preparatory arm backswing component*
Step 1	No backswing. The ball in the hand moves directly forward to release from the arm's original position when the hand first grasped the ball.
Step 2	Elbow and humeral flexion. The ball moves away from the intended line of flight to a position behind or alongside the head by upward flexion of the humerus and concomitant elbow flexion.
Step 3	Circular, upward backswing. The ball moves away from the intended line of flight to a position behind the head via a circular overhead movement with the elbow extended, or an oblique swing back, or a vertical lift from the hip.
Step 4	Circular, downward backswing. The ball moves away from the intended line of flight to a position behind the head via a circular down-and-back motion, which carries the hand below the waist.
	Humerus (upper arm) action component during forward swing
Step 1	Humerus oblique. The upper arm moves forward to ball release in a plane that intersects the trunk obliquely above or below the horizontal line of the shoulders. Occasionally, during the backswing, the upper arm is placed at a right angle to the trunk, with the elbow pointing toward the target. It maintains this fixed position during the throw.

Step 2	Humerus align but independent. The upper arm moves forward to ball release in a plane horizontally aligned with the shoulder, forming a right angle between humerus and trunk. By the time the shoulders (upper spine) reach front-facing, the upper arm and elbow have moved independently ahead of the outline of the body (as seen from the side) via horizontal adduction at the shoulder.
Step 3	Humerus lags. The upper arm moves forward to ball release horizontally aligned, but at the moment the shoulders (upper spine) reach front-facing, the upper arm remains within the outline of the body (as seen from the side). No horizontal adduction of the upper arm occurs before front-facing.
Forearm action component during forward swing	
Step 1	No forearm lag. The forearm and ball move steadily forward to ball release throughout the throwing action.
Step 2	Forearm lag. The forearm and ball appear to lag (i.e., to remain stationary behind the child or to move downward or backward in relation to the child). The lagging forearm reaches its farthest point back, deepest point down, or last stationary point before the shoulders (upper spine) reach front-facing.
Step 3	Delayed forearm lag. The lagging forearm delays reaching its final point of lag until the moment of front-facing
Foot action component in forceful throwing	
Step 1	No step. The child throws from the initial foot position.
Step 2	Homolateral step. The child steps with the foot on the same side as the throwing hand.
Step 3	Short contralateral step. The child steps with the foot on the opposite side of the throwing hand.
Step 4	Long contralateral step. The child steps with the opposite foot over a distance of more than half the child's standing height.

Note. From *Life Span Motor Development.* By K.M. Haywood and N. Getchell, 2014.

Throwing velocity. Each participant's throwing speed was measured. Children stood twenty feet from a wall and were directed to "throw as hard as they can" at the wall. The researcher gave a demonstration first, and then the participants followed with five trials in succession. Each participant was allowed to adopt a standardized starting position with both hands on the ball and the body facing the direction of the throw. Throwing velocity was measured using a tripod mounted Stalker Pro II radar gun (Stalker Inc., Plano, TX) and was interpreted as an index of overall power output (work per unit time), which reveals force production. The radar gun was mounted on a 3-ft. high tripod, 10 ft. in front of the participant (halfway to the wall) with the gun positioned directly into the path of the ball. Due to the potential of significant intra-variability of throwing speed with a population this young, the median score of the five throws was recorded and used for data analyses. Using the median score was selected to ensure that the subject's recorded maximum velocity was not based on a spurious velocity of a throw that was not reproducible.

Throwing practice. During the entire motor development program, one camera was dedicated to recording all activity at the throwing station. From the video records, the researcher retroactively calculated the total amount of time each participant spent at the throwing station, the number of visits to the throwing station, and the number of practice trials each participant had as well.

Throwing practice time. Engagement (time) at the throwing station was determined based on both the locale and behavior of the child. A child was considered to be 'at' and actively engaged in the throwing station if they were (a) performing a throwing task, or (b) surveying the station (i.e., monitoring the equipment and participants). It is reasonable to suggest that watching a station allowed a child to better learn how to perform the skill, and that the child should still be considered as engaged although they were not actively performing the task based on the research of observational learning models and motor skill acquisition (Herbert, in press). Total amount of time spent at the throwing station for each lesson was accumulated and a 'total time' score for each participant was used for data analysis.

Throwing practice visits. The number of visits by each participant at the throwing station was calculated using the recorded videos. Using the same criteria for throwing practice time, a participant was considered to have visited the station if they were actively engaged in the station, or if they were near the station watching others perform the task. While a throwing visit began when the time at the station began for each participant, each visit did not necessarily end when the time concluded. The visit was considered to be concluded only when the child left the location of the throwing station for at least fifteen seconds. If the child returned sooner than 15 seconds (e.g., chased a friend around the playground without engaging in another station), that was measured as the same visit. If the child left for more than fifteen seconds, the initial visit was considered to be concluded and a new visit (and time) began upon their return to the station.

Throwing practice trials. The number of practice trials each participant attempted during their time spent throwing was calculated using the recorded lesson videos. Given that some children were more skilled than others, each throwing trial that a participant attempted was counted as a trial regardless of whether or not the task was performed correctly. Total amount of practice trials during the time spent at the throwing station for each lesson was accumulated and a 'total trials' score for each participant was used for data analysis.

Guided throwing practice volume. There is little quantitative information on this particular area of study and distinguishes relevant variables and their inter-relationships on this subject matter. Moreover, this is one of the early research efforts at identifying the influence of practice (i.e., time, visits, trials) on throwing competency in preschool children. While we know that time, trials, and visits are all interrelated; the order of importance amongst these variables has yet to be determined. A correlation analysis could aid in determining exactly how inter-related these variables are, but they are often associated with practical problems. In comparison, a principal component analysis (PCA) is a statistical technique used to describe data in a smaller number of variables (grouping similar variables). The smaller set of variables (components) can be viewed as an overall description of the data set (Harris, 2001). PCA's are useful for data reduction and allow the researcher to explain as much of the total variance of the observed variables as possible (Preacher & MacCallum, 2003). For this reason, a principle 'component' variable was created to represent the total amount of throwing practice by grouping throwing time, visits, and trials. The results identified the first factor as very strong, accounting for 86% of the variance in practice visits, practice time, and practice trials. Thus, the factor scores from this analysis were used to represent practice by the children for the remaining linear regression analyses. This variable was referred to as 'guided throwing practice volume.'

Promoting experimental control. To promote experimental control, only the data from students who missed no more than two sessions, and who completed both the pre- and post-test were included in the analysis, resulting in a sample of 54 children.

Statistical Analysis

Data analyses were conducted using Statistical Package for the Social Sciences, version 23.0 (SPSS, Inc., Chicago, IL). Descriptive statistics were calculated for gender, pre-post TGMD, pre-post developmental sequence, pre-post velocity, and guided throwing practice volume. This study focused on research questions testing within subject differences (pre- and post-intervention) and relationship differences (throwing volume) on amount of change in skill.

The first research question will be answered using a paired-samples *t*-test to determine if the participants showed significant differences on the dependent variables (i.e., TGMD-3 throwing, Roberton and Halverson's developmental sequence for throwing, and throwing velocity) from pre- to post-test. The alpha level for significance was set at .05.

Multiple stepwise linear regression models were used to address research questions two, three, and four to determine the influence of throwing practice (i.e., trials, time, visits) on throwing competency variables. Regression analyses are used to: (1) identify if a relationship between two variables exists, (2) to describe the nature of the relationship, (3) to evaluate the accuracy of the magnitude achieved by the regression equation, and (4) specifically for multiple regression, to identify the importance of multiple predictor variables and how they contribute to variability in the criterion variable (Kachigan, 1991, pp. 161). A separate multiple stepwise linear regression model was used to analyze each throwing competency variable (TGMD-3, developmental sequence, velocity).

To address research question two, model changes in throwing velocity as a function of guided throwing practice volume and gender were assessed using a stepwise procedure in which variables were added to successive models. The model started with predicting *post-test throwing velocity* as a function of pre-test throwing velocity for each participant (model 0). We then added *guided throwing practice volume* as a predictor to determine if any additional variance was explained, while controlling for pre-test score (model 1). To test for potential gender differences, *gender* was added next to see if significant differences existed between boys and girls, controlling for both pre-test score and guided throwing practice volume (model 2). Finally, we added the interaction of gender by guided throwing practice volume to determine if any additional variance in post-test throwing velocity was explained, controlling for pre-test score, guided throwing practice volume, and gender (model 3).

To address research question three, model changes in TGMD-3 throwing competency as a function of guided throwing practice volume and gender were assessed using a stepwise procedure in which variables were added to successive models. The model started with predicting *post-test TGMD throwing score* as a function of pre-test TGMD throwing score for each participant (model 0). We then added *guided throwing practice volume* as a predictor to determine if any additional variance was explained, while controlling for pre-test score (model 1). To test for potential gender differences, *gender* was added next to see if significant differences existed between boys and girls, controlling for both pre-test score and guided throwing practice volume (model 2). Finally, we added the interaction of gender by guided throwing practice volume to determine if any additional variance in post-test throwing velocity was explained, controlling for pre-test score, guided throwing practice volume, and gender (model 3).

To address research question four, model changes in Roberton and Halverson's developmental sequence throwing competency as a function of guided throwing practice volume and gender were assessed using stepwise procedure in which variables were added to successive models. The model started with predicting *post-test Roberton and Halverson's developmental sequence score* as a function of pre-test Roberton and Halverson's developmental sequence score for each participant (model 0). We then added *guided throwing practice volume* as a predictor to determine if any additional variance was explained, while controlling for pre-test score (model 1). To test for potential gender differences, *gender* was added next to see if significant differences existed between boys and girls, controlling for both pre-test score and guided throwing practice volume (model 2). Finally, the interaction of gender guided throwing practice volume was added to see if any additional variance in post-test throwing velocity was explained, controlling for pre-test score, guided throwing practice volume, and gender (model 3).

Two separate steps were taken to address research question five: to what extent do children's characteristics (e.g., gender and initial skill level) relate to throwing practice behaviors? First, a *K* means cluster analysis was conducted to categorize children (i.e., higher, medium, and lower skilled) based on their pre-test throwing competency scores on the two process-oriented assessments (TGMD-3 throwing, Roberton and Halverson's developmental sequence for throwing). A cluster analysis is a statistical technique that is used to group individuals into homogenous sub-groups based on variables. The cluster analysis grouped the children into three groups or 'clusters.' Then a series of unpaired Welch assessments were run to determine if there were differences in the practice behaviors during the intervention (practice time, visits, and trials) based on gender and initial skill level. Welch assessments are used to compare the means of two groups with unequal variance.

Summary

Chapter 3 discussed the study's methods, research design, participants, instrumentation, data collection procedures, and data analyses for each research question. Chapter 4 will present the results of the quantitative analyses that answer each research question.

Chapter IV: Results

Evidence of throwing improvement

The results of the students' throwing competence tests are presented in Table 4.1. On all three measures (TGMD-3, velocity and developmental sequence), the children showed significant gains from pre- to post-test. Analysis of the effect sizes provides evidence that these gains ranged from 0.74 to l.42 (from moderate to very large). Results indicate that participants showed significant improvements in each of the throwing competence measurements after participation in the intervention.

Table 4.1

Descriptive Statistics and Paired Sample T-Test Results for TGMD-3, Developmental Sequence for Throwing, and Throwing Velocity.

Outcome		Pretest M (SD)	Posttest M (SD)	95% CI for Mean Difference	*t*	*p*	*d*
TGMD-3							
	All	4.26 (2.47)	6.17 (2.02)	-2.61, -1.20	-5.45	<.001	0.74
	Boys	5.63 (2.53)	7.21 (1.10)				
	Girls	3.17 (1.82)	5.33 (2.22)				
DS							
	All	8.50 (2.16)	11.50 (2.64)	-3.58, -2.42	-10.40	<.001	1.11
	Boys	9.83 (1.97)	12.75 (2.41)				
	Girls	7.43 (1.67)	10.50 (2.40)				
Velocity							
	All	12.53 (3.58)	15.93 (4.15)	-4.24, -2.57	-8.17	<.001	1.42
	Boys	14.18 (3.56)	18.21 (4.25)				
	Girls	11.21 (3.04)	14.11 (3.09)				

Note. *df* = 53 (24 boys, 30 girls)

A paired samples *t*-test were used to determine whether there was a statistically significant change in the children's throwing competence (TGMD-3, developmental sequence for throwing, and throwing ball velocity) from pre- to post-intervention. No outliers were detected that were more than 1.5 box-lengths from the edge of the box in a boxplot. The assumption of normality was not violated, as assessed by visual inspection of Normal Q-Q and histogram plots. There were significant differences in throwing competency from pre- to post-test on the TGMD-3 ($t_{53} = -5.45$, $p < .001$, $d = 0.74$), developmental sequence for throwing ($t_{53} = -8.17$, $p < .001$, $d = 1.11$), and throwing ball velocity ($t_{53} = -10.40$, $p < .001$, $d = 1.42$). Based on the present sample, it appears that children's throwing competence improved after participation in the intervention. Data are mean ± standard deviation, unless otherwise stated. Participants throwing competence on the TGMD-3 improved from pre (4.26±2.47) to post-test (6.17±2.02). Additionally, participants throwing competence as measured by the developmental sequence of throwing improved from pre (8.50±2.167) to post-test (11.5±2.64). Finally, participants throwing ball velocity improved from pre (12.53±3.58 mph) to post-test (15.93±4.15 mph).

Predictions on throwing improvement

Multiple stepwise linear regressions were used to determine the influence of guided practice volume on throwing competence. For each model, there was independence of residuals, as assessed by the Durbin-Watson statistics ($p > .05$). Linear relationships existed between the criterion and each of the predictor variables, and between the predictor and criterion variables collectively. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. The data did not show multicollinearity, as assessed by VIF values which were not greater than 10. No outliers existed, and the residuals were normally distributed.

Predictions on post-test TGMD-3.

Multiple stepwise linear regressions were run to determine if the addition of guided practice volume, gender, and the interaction of gender and guided practice volumes improved the prediction of post-test TGMD-3 score over and above pre-test TGMD-3 scores alone (Model 1). The full model of pre-test score, guided practice volume, gender, and an interaction of gender by guided practice volume (Model 4) was statistically significant, $R^2 = .603$, $F(1, 49) = 6.99$, $p < .001$; adjusted $R^2 = .311$. The addition of guided practice volume to the prediction of post-test TGMD-3 score (Model 2) led to a statistically significant increase in R^2 of .060, $F(1, 51) = 3.791$, $p < .00$, controlling for pre-test TGMD-3 score. The addition of gender to the prediction of post-test TGMD-3 (Model 3) also led to a statistically significant increase in R^2 of .098, $F(1, 50) = 6.847$, $p < .001$, controlling for both pre-test TGMD-3 scores and guided practice volume. See Table 4.2 for full details on each regression model including standardized and unstandardized model coefficients.

Table 4.2

Hierarchical Multiple Regression Predicting TGMD Post-test Throwing Competency From Pre-test, Guided Practice Volume, and Gender.

	TGMD-3 Throwing							
	Model 1		Model 2		Model 3		Model 4	
Variable	B	β	B	β	B	β	B	β
Constant	4.91**		5.26**		5.94**		6.14**	
Pre-test	0.29*	0.36	0.21	.258	0.07	0.08	0.07	0.09
Guided Practice			0.53	.266	0.49	0.24	1.17*	0.60
Gender					-0.73	-0.36	-0.59	-0.29
Gender x Guided practice							0.90*	0.43
R^2	0.13		0.19		0.29		0.36	
F	7.75*		5.98*		6.73*		6.99**	
ΔR^2	0.13		0.06		0.10		0.08	
ΔF	7.75		3.79		6.85*		5.85*	

Note. N=54. * p <.05, ** p <.001.

Predictions on post-test developmental sequence of throwing.

Multiple stepwise linear regressions were run to determine if the addition of guided practice volume, gender, and the interaction of gender and guided practice volumes improved the prediction of post-test developmental sequence score over and above pre-test developmental sequence scores alone (Model 1). The full model of pre-test score, guided practice volume, gender, and an interaction of gender by guided practice volume (Model 4) was statistically significant, $R^2 = .533$, $F(1, 49) = 13.968$, $p < .001$; adjusted $R^2 = .495$. The addition of guided practice volume to the prediction of post-test developmental sequence score (Model 2) led to a statistically significant increase in R^2 of .116, $F(1, 51) = 12.099$, $p = .001$, controlling for pre-test scores. The addition of gender (Model 3) did not explain any additional variance to the prediction of post-test developmental sequence score (change in $R^2 = .008$, $F(1, 50) = .841$, $p = .364$). The addition of a gender by guided practice volume (model 4) also did not significantly explain any additional variance in post-test developmental sequence score (change in $R^2 = .016$, $F(1, 49) = 1.628$, $p = .208$). See Table 4.3 for full details on each regression model including standardized and unstandardized model coefficients.

Table 4.3

Hierarchical Multiple Regression Predicting Developmental Sequence Post-test Throwing Competency From Pre-test, Guided Practice Volume, and Gender.

	Developmental Sequence of Throwing							
	Model 1		Model 2		Model 3		Model 4	
Variable	B	β	B	β	B	β	B	β
Constant	4.99**		6.66**		7.31**		7.38**	
Pre-test	0.77**	.63	0.57**	0.47	0.50*	.417	0.50*	0.41
Guided Practice			1.00**	0.37	0.99*	.386	1.39*	0.53
Gender					-0.29	-0.11	-0.19	-0.07
Gender x Guided practice							0.52	0.19
R^2	0.39		0.51		0.52		0.53	
F	33.62**		26.45**		17.86**		13.97**	
ΔR^2	0.39		0.12		0.01		0.02	
ΔF	33.62**		12.10**		0.84		1.638	

Note. N=54. * p <.05, ** p <.001.

Predictions on post-test throwing ball velocity.

A hierarchical multiple regressions were run to determine if the addition of guided practice volume, gender, and the interaction of gender and guided practice volumes improved the prediction of post-test throwing velocity score over and above pre-test throwing velocity scores alone (Model 1). The full model of pre-test score, guided practice volume, gender, and an interaction of gender by guided practice volume (Model 4) was statistically significant, R^2 = .640, $F(1, 49) = 21.759$, $p < .001$; adjusted R^2 = .610. The addition of guided practice volume to the prediction of post-test throwing velocity score (Model 2) led to a statistically significant increase in R^2 of .112, $F(1, 51) = 14.227$, $p < .001$, controlling for pre-test scores. The addition of gender (Model 3) had a significant effect explaining another 4% of the variance in post-test velocity score (change in R^2 = .041, $F(1, 50) = 5.689$, $p = .021$). The addition of a gender by guided practice volume (model 4) did not significantly explain any additional variance in post-test throwing velocity score (change in R^2 = .001, $F(1, 49) = .168$, $p = .684$). See table 4.4 for full details on each regression model including standardized and unstandardized model coefficients.

Table 4.4

Hierarchical Multiple Regression Predicting Throwing Velocity Post-test Speed From Pre-test, Guided Practice Volume, and Gender.

	Throwing Velocity							
	Model 1		Model 2		Model 3		Model 4	
Variable	B	β	B	β	B	β	B	β
Constant	5.80**		8.37**		9.72**		9.59**	
Pre-test	0.81**	0.70	0.60**	0.52	0.50**	.434	0.52**	0.45
Guided Practice			1.57**	0.38	1.51**	.364	1.68*	0.40
Gender					-0.93*	-0.223	-0.87*	-0.21
Gender x Guided practice							0.24	0.06
R^2	0.49		0.60		0.64		0.64	
F	48.99**		37.84**		29.45**		21.76**	
ΔR^2	0.49		0.11		0.04		0.01	
ΔF	49.00**		14.23**		5.69*		0.17	

Note. N=54. * p <.05, ** p <.001.

Differences in practice behaviors

Participants' practice behaviors (i.e., how much time, visits, and trials they had) during the intervention were also examined based on their gender and skill level. Then a series of Welch's *t*-tests were run to determine if there were differences in the practice behaviors during the intervention (practice time trials, and visits) based on gender. Welch's *t*-test is an assessment used to compare the means of two groups with different sample sizes and variances Welch's *t*-test does not have the assumption of equal variance, but assumption of normality was met. Differences were considered statistically significant at $P < 0.05$.

By gender.

A Welch *t*-test was conducted to determine if practice time, trials and visits during the mastery motivational climate intervention were different between boys and girls. Table 4.5 presents the descriptive statistics of practice behaviors by gender. Practice time was significantly different between groups, Welch F (1, 29) = 5.06, p =.032. There was also a significant difference in the amount of practice trials between groups, Welch F (1, 25) = 6.57, p =.017. There was no difference in the number of practice visits between groups, Welch F (1, 33) = .04, p =.852. These data are also presented in Table 4.6.

Table 4.5

Descriptive Statistics on Practice Behaviors by Gender.

	Gender	Mean	*SD*	*N*
Time (secs)	Boys	3084.3	2738.7	24
	Girls	1759.1	1015.1	30
	Total	2348.0	2064.1	54
Visits (number)	Boys	11.5	7.7	24
	Girls	11.9	4.0	30
	Total	11.7	5.9	54
Trials (total)	Boys	264.7	260.0	24
	Girls	124.8	69.4	30
	Total	187.0	192.0	54

Note. 24 Boys, 30 Girls

Table 4.6

Welch t-test Results for Differences in Throwing Practice Behaviors by Gender

	Boys *M* (*SD*)	Girls *M* (*SD*)	*t (df)*	*p*
Time (secs)	3084.3 (2738.7)	1759.1 (1015.1)	5.06 (29)	.032
Visits (number)	11.5 (7.7)	11.9 (4.0)	.04 (33)	.852
Trials (total)	264.7 (260.0)	124.8 (69.4)	6.57 (25)	.017

Note. 17 Higher, 22 Medium, 15 Lower

By skill level.

A *k-means* cluster analysis was used to categorize children into three separate groups (lower, medium, and higher skilled) based on their pre-test scores on the TGMD-3 and developmental sequence for throwing. Then a one-way Welch ANOVA was conducted to determine if practice time, trials and visits during the mastery motivational climate intervention were different between the higher (n=17), medium (n=22), and lower skilled (n=15) children. Table 4.7 presents the descriptive statistics of practice behaviors by skill level. Practice time was significantly different between groups, Welch F (1, 29) = 5.06, p =.013. There was also a significant difference in the amount of practice trials between groups, Welch F (1, 29) = 5.51, p =.009. There was no difference in the number of practice visits between groups, Welch F (1, 30) = 1.33, p =.279. These data are also presented in Table 4.8. Tukey post-hoc analysis revealed that the higher skilled children had significantly more practice time than the lower skilled children (p = .006), but were not significantly different than the medium skilled children (p = .704). The medium skilled children also had significantly more practice time than the lower skilled children (p = .024). Tukey post-hoc analysis also revealed that the higher skilled children had significantly more practice trials than the lower skilled children (p = .002), but were not significantly different than the medium skilled children (p = .795). The medium skilled children also had significantly more practice trials than the lower skilled children (p = .005).

Table 4.7

Descriptive Statistics on Practice Behaviors by Skill Level.

	Skill level	Mean	*SD*	*N*
Time (secs)	Lower	1457.5	593.9	15
	Medium	1964.8	1310.9	22
	Higher	3629.8	2976.2	17
	Total	2348.0	2064.1	54
Visits (number)	Lower	10.0	3.9	15
	Medium	11.7	4.4	22
	Higher	13.1	8.3	17
	Total	11.7	5.9	54
Trials (total)	Lower	103.0	51.7	15
	Medium	140.0	92.1	22
	Higher	321.8	282.4	17
	Total	187.0	192.0	54

Table 4.8

Welch One-Way ANOVA Results for Differences in Throwing Practice Behaviors by Initial Skill Level.

	Higher *M* (*SD*)	Medium *M* (*SD*)	Lower *M* (*SD*)	*t (df)*	*p*
Time (secs)	3629.8 (2976.2)	1964.8 (1310.9)	1457.5 (593.9)	5.06 (29)	.013
Visits (number)	13.1 (8.3)	11.7 (4.4)	10.0 (3.9)	1.33 (30)	.279
Trials (total)	321.8 (282.4)	140.0 (92.1)	103.0 (51.7)	5.51 (29)	.009

Note. 17 Higher, 22 Medium, 15 Lower

Chapter V: Discussion

The purpose of this study was to determine if the volume of guided throwing practice children accrue during a mastery motivational climate intervention influences improvements in different aspects of overhand throwing. Overall, the results of this study suggest that the children's throwing competency improved. Specifically, guided throwing practice volume contributed to changes for each of three throwing variables as it accounted for 19% (TGMD), 52% (developmental sequence), and 60% (velocity) of the explained variance, respectively. Furthermore, with the exception of TGMD, gender did not appear to be a significant predictor variable in any of the statistical models. The discussion which follows will identify consistencies and/or inconsistencies with previous studies as they relate to the results of this study. Potential future research topics will also be discussed.

Research Question 1: Does children throwing competency change as a result of exposure to mastery climate?

The hypothesis that students who are exposed to a mastery motivational climate will demonstrate significant improvement in throwing competency (as measured by the TGMD-3 assessment, Roberton and Halverson's developmental sequence for throwing, and throwing velocity) was fully supported by the results of the paired-samples *t*-test. The findings from this study support those reported in previous motor skill interventions which show that children can achieve significant improvements in their skill development when given purposeful instruction (Apache, 2005; Bardid et al., 2017; Deli et al., 2006; Goodway & Branta, 2003; Goodway et al., 2003; Hamilton et al., 1999; Hamilton et al., 2017; Ignico, 1991). In addition, the effect sizes associated with the current results support those from earlier autonomy-supportive climate interventions (i.e., mastery motivational climate physical education programs) where greater skill improvements were achieved than in less autonomous instructional climates (Hastie et al., 2013; Logan et al., 2012; Martin et al., 2009; Robinson, 2011; Robinson & Goodway, 2009; Rudisill, 2016; Theeboom et al., 1995; Valentini & Rudisill, 2004a, 2004b; Valentini et al., 2017). It should be noted however, that while each of these studies support the findings of the current study, they all focused on overall fundamental motor skill improvements, whereas this study targeted overhand throwing specifically. By consequence, none of the aforementioned studies presented individual scores for each of the skills that make up the ball skills subtest, reporting only improvement in ball skills. Further, the effect sizes for each individual skill are left to be both assumed and of equally weighted values (e.g., skill improvement in overhand throwing was the same as improvement in another skill such as underhand throwing). This study provides specific data for overhand throwing improvements in children as a result of exposure to a mastery climate physical education program.

While mastery climate studies have focused on the general presentation of locomotor and ball skills data, there are a number of studies that show evidence of improved overhand throwing following directed practice. However, each of these were conducted in a laboratory-based setting (Capio et al., 2013; Chen et al., 2016; Cohen et al., 2012; Lorson & Goodway, 2007; Stodden, 2002). For example, Lorson and Goodway (2007) highlighted the benefits of providing critical cues and task constraints on body-component levels (i.e., Roberton's developmental sequence of throwing) for second and third grade children. They found cues, task, and task-feedback to be beneficial for throwing competence and throwing velocity. Moreover, in this refined environment, each participant threw exactly 60 throws in which they received different forms of feedback following each throw. Additionally, overhand throwing was the only skill being practiced in the lab. While extremely useful, these findings may lack external validity to physical education settings. What the current study adds to the literature on children's throwing is that skill gains are indeed possible in a naturalistic setting where multiple skills are being taught, particularly when that setting adopts a mastery motivational climate.

Future research: Expanding the understanding of mastery motivational climate effectiveness

Previous motor skill development studies in naturalistic settings have highlighted skill improvement for children after participation in a mastery motivational climate physical education program (Hastie et al., 2013; Rudisill, 2016). However, a majority of these studies have yet to fully identify what is happening *during* these interventions that elicit these results. To date, only the studies of Hastie et al. (2016) and Hastie, Johnson, and Rudisill (2017) have delved into the "black box" of mastery climate interventions and have included substantial details of students and teacher behaviors during lessons. To begin with, Hastie et al. (2016) conducted an ecological analysis and found time to be a significant factor for how children took advantage of the amount of autonomy afforded to them in a mastery climate. Children's on task-behaviors and levels of engagement during the lessons increased both across time and within lessons (Hastie et al., 2016). Thereafter, Hastie and colleagues (2017) characterized the attraction and holding power of activity stations within mastery climates and proposed that teachers should design stations that are novel, authentic, and developmentally appropriate in order to entice children to visit a station. Moreover, activity stations with the most holding power were built for success by the teacher, had potential for modification, and afforded the children frequent indicators of progress. Despite these findings, there still remains a need to expand on how children practice across all motor skills and relate these practicing behaviors to skill improvements, as well as opportunities to respond (i.e., the number of days that different skills are available for practice during intervention). In general, we have been left to hypothesize that the climate itself, based on the theoretical underpinnings of the TARGET structures, leads to more intrinsically motivated learners, which by default may or may not suggest that children will engage in more practice. However, limited empirical evidence of the relationship between skill practice and skill improvement has been provided prior to this study. Although there was no control group, at least for throwing, this study provides empirical evidence that guided practice volume during a mastery climate program indeed explains a significant amount of variance in the changes in skill improvement for throwing proficiency and velocity. Future studies should determine if this relationship between guided practice volume and skill improvement holds true for other fundamental motor skills.

Research Question 2: What is the extent to which guided throwing practice volume influences gains in TGMD throwing competency (as measured by the TGMD-3 assessment)?

The results of the step-wise multiple linear regression model on post-test TGMD throwing scores confirm that guided throwing practice volume was certainly a significant predictor of throwing competence, which supports the hypothesis. The amount of practice children participated in during the intervention accounted for about 19% of the variance in post-test scores after controlling for pre-test scores, which is a medium effect size. Moreover, in the full regression model guided practice volume became less significant after accounting for a gender by guided practice volume interaction.

There is currently no literature that has matched practice volume with specific improvements in a TGMD skill such as overhand throwing. The following discussion offered on these results will focus on the scores of the assessment. To begin with, the TGMD has a ceiling score of 8 and many of the boys had inflated pre-test scores that were already approaching the maximum score (5.63 out of a possible 8). These elevated scores may have had an impact on the results of the regression model, as the boys in this study were left with little scope for significant improvement, while at the same time accumulating more guided practice. This was compounded when noting that the mean scores for girls TGMD throwing at baseline were significantly lower at 3.17. As a case in point, while the girls made a 68% improvement in throwing (from 3.17 to 5.33), the boys mean scores improved by only 28% (from 5.63 to 7.21). By the end of the intervention, the boys displayed advanced skill proficiency as a group which is defined by scoring at least seven out of eight (Okely & Booth, 2004). In fact, 66% of the boys (16 of 24) hit the "ceiling" score of 8 on the post test, compared to just 16% of the girls (5 of 30). So while the results of the full regression (model 4), would suggest that the girls improved their TGMD throwing development at a higher rate than the boys (with less practice), the implications of these findings might be limited by a ceiling effect of the boys scores.

Other attributes of the TGMD-3 assessment itself may have also attributed to why guided practice volume accounted for only 19% of the variance in skill change in comparison to the other two dependent variables in which guided practice volume explained greater than 50% of the variance. As previously stated, both the TGMD-3 and Roberton's developmental sequence for throwing are both considered to be process-oriented assessments. However, the TGMD-3 is specifically a comprehensive process measure of overall FMS, which differs from the developmental sequence assessment designed to specifically measure the body-component of process overhand throwing. Accordingly, the performance criteria associated with each assessment differ in the sense that the components for Roberton's developmental sequence are much more advanced and precise. For example, the proper foot action (stepping in opposition) is critical to correctly performing an overhand throw. Both assessments do indeed consider this important component of a throw, but according to the performance criteria on the TGMD-3 (Table 3.1) children received a score of "1" no matter how the step was performed. On the other hand, the performance criteria associated with the foot action component on Roberton's developmental sequence for throwing (Table 3.2) differentiates between a short (a score of 3) and a long (a score of 4) contralateral step. A long contralateral step must be at least half of the child's standing height. Differences such as these are also prevalent between the two assessments on each of the other performance criteria. The rudimentary stages of throwing measured on the TGMD-3 could have contributed to the differences in the explained variance compared to other dependent variables. Future research should attempt to replicate these findings using boys and girls who are of similar skill levels on baseline TGMD-3 throwing to determine if there is a true gender by guided practice volume interaction on the full regression model.

Research Question 3: What is the extent to which guided throwing practice volume influences gains in Roberton and Halverson's developmental sequence for throwing?

Guided throwing practice volume was also a significant predictor in the step-wise multiple linear regression model on post-test developmental sequence scores, which supports the hypothesis. In fact, practice accounted for about 52% of the variance after controlling for pre-test scores, which is a large effect size. These findings are a new contribution to the literature as no one has really looked at practice (especially across multiple throwing assessments that allow us to see change), and it appears to be a very important factor in learning to throw. More discussion and the implications of these findings will be elaborated on later in this chapter.

Future research should examine the relationship between guided practice volume and Roberton's developmental sequence for throwing in older children who are more skilled. This will help determine if the amount of practice becomes more or less important based on skill level (does it take more or less practice for non-novice throwers to improve at similar rates?), and to determine if a specific type of practice (time or trials) is more important for development.

Research Question 4: What is the extent to which guided throwing practice volume influences gains in throwing velocity?

Of each of the three throwing assessments measured in this study, practice volume was the most significant predictor for post-test throwing velocity as it explained roughly 60% of the variance that was accounted for. These data support the hypothesis. Additionally, gender was also a significant predictor variable in the full model as gender differences existed between boys and girls throwing velocity. These results are similar to those of Thomas and French (1985) who also found gender differences between throwing velocity in boys and girls. More importantly, there was no gender by practice volume interaction in the regression models which suggests that guided practice volume itself was a more important predictor variable than gender as both groups showed improvements at similar rates of practice. Interestingly, Roberton and Konczak (2001) conducted a study where they used stepwise regressions to predict children's throwing velocity based on their developmental levels of each throwing component per Roberton's sequence for throwing. While gender was initially found to be a good predictor of ball velocity, when the developmental levels were controlled for in the regression model, gender only explained no more than 2% of additional variance in throwing velocity. In the same fashion, guided practice volume was a much stronger predictor than gender in this case as well. What should also be noted is the similarity between the explained variance by developmental sequence level (72%) by Roberton and Konczak (2001) and guided practice volume in the present study (60%). Future research should continue to examine important predictor variables of throwing ball velocity in children using regression models, but should include both developmental levels and guided practice volume as predictors in the same model to help identify the significance of each after controlling for the other.

Implications of the importance of guided practice

Previous research in motor learning has highlighted the importance of skill practice. In fact, Lee, Chamberlin, and Hodges (2001, p. 36) suggested that "if anything is certain in motor learning it is that there is no better, faster, or more efficient way of achieving it than with practice." Schmidt & Lee (2005, p. 322) add that "one practice variable dwarfs all the others in terms of importance and is so obvious that it need hardly be mentioned at all – practice". In addition, Williams, Haywood, and Painter (1996) also attributed differences in boys and girls throwing patterns to greater practice by the boys, based on a study where they found no differences between boys and girls nondominant throwing hand (it was assumed that children do not often spend time practicing throwing with their nondominant hand). Moreover, until now there has been little to no information on how much or what type of practice is necessary for the skill development of young children in overhand throwing. Overall, these results suggest that similar to the findings of previous motor development and pedagogical intervention studies (Cohen et al., 2012; Lorson & Goodway, 2007; Silverman, 1985), and congruent with research in motor learning, practice is indeed a major variable in children's motor skill development.

Methodological implications

This section will highlight some key methodological implications based on the design of this study. Specifically, (a) the benefits of using more than one dependent variable to assess throwing, and (b) the novelty of using guided practice volume as a latent variable.

Previous studies of overhand throwing have primarily used just one measure of throwing competence for each study. Some studies on throwing have used product-oriented assessments such as throwing ball velocity where the primary concern is on the outcome (Garcia & Garcia, 2002; Stodden et al., 2006a,b), while others have used process- oriented throwing assessments that are within larger fundamental motor skill batteries such as the TGMD-2 where the focus is on the development of the skill (Martin et al., 2009). While other studies have used component assessments as dependent measures (Lorson & Goodway, 2008, Roberton & Halverson, 1984; Stodden & Rudisill, 2006). Other than a few overhand throwing studies that employed both process and product-oriented assessments (Cohen et al., 2012; & Roberton and Konczak 2001), traditionally most studies have only assessed throwing in one way or the other. In this study, using three multiple dependent measures of throwing competence (TGMD-3, developmental sequence, and throwing velocity) allowed us to gain a more comprehensive view of the development of children's throwing skill from a product and process perspective. As noted by Cohen, Goodway, & Lidor (2012, p.539) "understanding the relationships between the process (throwing pattern) and the product (throwing velocity) of the learned task can assist PE teachers to better design their instructional units." Moreover, Logan, Barnett, Goodway, and Stodden (2016) compared young children's (ages 4 to 11) motor skill performances across process- and product-oriented assessments to determine the ability of process-oriented assessments to classify children based on skill level. They suggest an increase in the strength of the relationship between process- and product-oriented overhand throwing assessments across age groups.

Future studies should continue this trend of using multiple dependent measures for throwing to help gain an expanded picture given that each throwing assessment has its own benefits and limitations. This is particularly the case for process measures such as the TGMD-3 which have potential ceiling effects and a low sensitivity level in discriminating between advanced and non-mastery skill levels (Logan et al., 2016), yet provide normative data for skills until age 11. On the other hand, Roberton and Halverson's developmental sequence for throwing lacks normative data for specific age groups. Yet it remains an extremely beneficial assessment that can be employed in longitudinal studies as young children are not likely to completely master every throwing component that is analyzed until age 11 and perhaps beyond adolescence for some individuals. Additionally, the developmental sequence for throwing had the highest sensitivity to detect skill level in overhand throwing (Logan et al., 2016). Finally, the use of product assessments such as throwing velocity are highly cited in much of the throwing literature and have been found to be related to outcomes such as skill-specific outside physical activity (Raudsepp & Pall, 2006) and overall fitness levels of adults (Stodden et al., 2009). However, these types of assessments could potentially undermine actual skill development as the overarching goal is to simply throw for speed regardless of how the skill is performed. As a whole, the results of this study would suggest it beneficial to use multiple dependent measures to assess overhand throwing.

Use of a latent construct variable.

The results of this study also present some additional methodological benefits of measuring a latent construct variable such as "guided throwing practice volume." Although latent construct variables are not directly observed, in this case guided throwing practice volume proved to be a more robust dependent measure that not only can be easily calculated in field settings (i.e., measuring visits, time, and trials), but also afforded a more comprehensive account for practice other than simply measuring practice trials or practice time as previous studies have reported (Silverman, 1985; Williams, Haywood, & Painter, 1996). As a case in point, in laboratory based studies dependent measures such as practice visits and time become irrelevant as there is no variability in these measurements between participants (i.e., all participants come for “x” number of visits for “y” amount of time). Given that there are few studies on overhand throwing in naturalistic field settings, measuring guided throwing practice volume appears to be more meaningful and beneficial for the external validity of previous studies on overhand throwing.

Research Question #5: To what extent do children’s characteristics (gender and initial skill level) relate to guided throwing practice volume?

Gender

The hypothesis that boys would spend more time practicing overhand throwing during the intervention was supported based on the difference in the amount of guided practice volume between boys and girls. Previous studies of overhand throwing have reported significant gender differences in performance as early as four or five years of age (Butterfield et al., 2012; Butterfield & Loovis, 1993; Halverson et al, 1977; Nelson, Thomas, Nelson, & Abraham, 1986; Thomas & French, 1985). Further, as noted by Nelson, Thomas, and Nelson (1991), these differences increase by age eight and only become greater by age thirteen (Roberton & Konczak, 2001). The results of this study confirm the gender differences found in previous studies, as boys were significantly better at throwing at both pre- and post-test. Although they never formally measured practice, Nelson et al. (1991) posit that some of these differences result from the lack of practice. Recently, Thomas and colleagues (2010) examined gender differences in Aboriginal Australian boys and girls and found them to be more similar in throwing ball velocity and kinematics in comparison to boys and girls from the United States. The authors posit that the cultural expectations of Aboriginal people as hunters and gatherers using throwing weapons may help explain why the girls revealed a closer relationship to the throwing skill level of the boys. Perhaps it can be implied that the cultural experiences of young Aboriginal girls allow them to accrue more overhanding throwing practice, and thus explain why they are more similar to their male counterparts in comparison to children from other countries. The findings from this study would align with such an assertion as girls did indeed spend a significantly lower amount of time practicing compared to boys (see Table 4.6). The question then becomes, how do we make throwing tasks more enticing for girls in order to increase sustained engagement? According to Hastie et al. (2018), within a mastery motivational climate, activities that exude the most holding power for young children are built for success, incorporate progress points, and have potential for modification. It may well be that the other activities offered within the program had higher levels of attraction and holding power for girls. Future studies should explore if and how girls and boys spend their time differently during mastery motivational climate and other autonomy-supportive physical education programs.

Skill level

An additional aim of this study was to determine if there was a difference in guided throwing practice volume variables based on initial skill level at pre-test. The findings support the hypothesis and suggest that the children who were considered higher skilled spent both more time at the throwing station and also had more practice trials compared to children who were classified as lower and medium skilled. However, there were no differences between both the practice time and practice trials between the two latter groups (Table 4.8). Additionally, there were no group differences found between the number of throwing visits. The discussion and implication of these results are detailed below.

Based on these results, it appears as if the "rich continue to get richer" as the higher skilled children had the most practice and showed the most improvements. Given the nature of mastery climates and the autonomy that the children are given, it appears reasonable to hypothesize that the perceived physical competence of the participants may have had an impact on how much practice they engaged in. Perceived physical competence is defined as the way an individual views his/her physical abilities and has been well researched. To begin with, Harter (1978), posited that persistence and continued participation in a task was mediated by an individual's perceptions of how skilled they were at a specific task or activity. Since then perceived competence has been identified as an influential factor in children's motivation to engage in physical activity and movement related activities (Barnett et al., 2009; Stodden et al., 2008), as well as fitness (Raudsepp, Liblik, & Hannus, 2002; Stodden et al., 2009). Moreover, Robinson (2011) found a moderate relationship between perceived physical competence and actual fundamental motor skill competence. Taken together, the idea that the children who were considered higher skilled visited the throwing station the same number of times as the other children, yet stayed for nearly twice as long and accrued more than two times the amount of the practice trials as the medium skilled children could potentially have been mediated by their perceived competence on the throwing tasks. That presumption of a relationship between skill level, perceived competence, and practice, of course, awaits further study in which the children's perceived competence would be measured. Most importantly, if perceived competence is in fact a mediating variable in practice behaviors for throwing, such a relationship would be promising towards efforts to encourage children to engage in more throwing practice as mastery climate interventions have been found to increase levels of perceived physical competence in children (Valentini & Rudisill, 2004a,b).

Another potential explanation for the difference in guided practice volume between the higher and lower skilled children could have been the actual tasks within the throwing station. The *tasks* and *task options* offered within a mastery climate are essential components of the learning environment. This includes both the design of the instructional activities as well as the difficulty of the task. Raffini (1993) contends that instructors need to be cognizant of the skill level of each student in order to provide a variety of challenging tasks. In turn, this will foster the mastery goals of all learners, irrespective of skill level. The question then becomes were the practice behaviors affected by the tasks offered at the throwing station? Simply stated, were the throwing tasks included in this study perhaps too difficult for the lower skilled children? Within a mastery motivational climate, the potential for a task to be modified was highlighted as one of the critical components of the holding power (sustained engagement) of an activity station according to Hastie and colleagues (Hastie et al., 2018).

Conclusion and Limitations

This study provides empirical evidence of the importance of practice for the development of young children's overhand throwing learning in a naturalistic setting. Although care was not taken to control for variables (e.g. practice time beyond class or motivation) that may have impacted the results of the study, it is impossible to control for all such variables in these types of settings. Additionally, the amount of instruction and feedback given to each participant was not controlled for during this study. However, it is typical that in a naturalistic physical education setting, not all students will receive identical amounts of instruction and feedback. Indeed, controlling the feedback and instruction was therefore not a goal of this study. Rather, age and skill appropriate feedback and instruction was provided to all participants during the intervention on an individual basis. Future studies should continue to examine the influence of practice on fundamental motor skills such as throwing to identify a specific threshold of practice that may be necessary to become a proficient overhand thrower.

References

Adams, D. (2001). The relative effectiveness of three instructional strategies on the learning of an overarm throw for force. *The Physical Educator*, *58*(2), 67-77.

Ames, C. (1992a). Achievement goals, motivational climate, and motivational processes. In G.C. Roberts (Ed.), *Motivation in sport and exercise* (pp. 161-176). Champaign, IL: Human Kinetics Publishers.

Ames, C. (1984a). Achievement attributions and self-instructions under competitive and individualistic goal structures. *Journal of Educational Psychology*, *76*, 478-487.

Ames, C. (1984b). Competitive, cooperative, and individualistic goal structure: A cognitive-motivational analysis. In R. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol.1, pp. 177-208). New York: Academic Press.

Ames, C. (1992b). Classroom: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*, 261–271. doi:10.1037/0022- 0663.84.3.261.

Ames, C., & Archer, J. (1987). Mother's belief about the role of ability and effort in school learning. *Journal of Educational Psychology*, *79*, 409-414. doi:10.1037/0022-0663.79.4.409

Ames, C., & Archer, J. (1988). Achievement of goals in the classroom: Students' learning strategies and motivation process. *Journal of Educational Psychology*, *80*, 260-267. doi:10.1037/0022- 0663.80.3.260

Apache, G. R. R. (2005). Activity-based intervention in motor skill development. *Perceptual and motor skills*, *100*, 1011-1020.

Bardid, F., Lenoir, M., Huyben, F., De Martelaer, K., Seghers, J., Goodway, J. D., & Deconinck, F. J. (2017). The effectiveness of a community-based fundamental motor skill intervention in children aged 3–8 years: Results of the “Multimove for Kids” project. *Journal of Science and Medicine in Sport*, *20*, 184-189.

Barkoukis, V., Koidou, E., & Tsorbatzoudis, H. (2010). Effects of a motivational climate intervention on state anxiety, self-efficacy, and skill development in physical education. *European Journal of Sport Science*, *10*, 167-177.

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health*, *44*, 252-259.

Barrett, D. D., & Burton, A. W. (2002). Throwing patterns used by collegiate baseball players in actual games. *Research Quarterly for Exercise & Sport*, *73*, 19-27.

Barrett, K. C., & Morgan, G. A. (1995). Continuities and discontinuities in mastery motivation in infancy and toddlerhood: A conceptualization and review. In R.H. MacTurk & G.A. Morgan (Eds.), *Mastery motivation: Origins, conceptualizations, and* applications (pp. 57-93).

Biddle, S., Akande, A., Vlachopoulos, S., & Fox, K. (1996). Towards an understanding of children’s motivation for physical activity: Achievement goal orientations, beliefs about sport success, and sport emotion in Zimbabwean children. *Psychology & Health*, *12*, 49–55. doi:10.1080/08870449608406921

Burns, J. (2017, June 23). *Alabama Council on Human Relations, Inc.* Retrieved August 1, 2017, from http://achr.com

Burton, D. (1989). Winning isn’t everything: Examining the impact of performance goals on collegiate swimmers’ cognitions and performance. *The Sport Psychologist*, *3*, 105-132.

Burton, A. W., & Miller, D. E. (1998). *Movement skill assessment*. Champaign, IL: Human Kinetics.

Butler, R. (1987). Task-involving and ego-involving properties of evaluations: The effects of different feedback conditions on motivational perceptions, interest and performance. *Journal of Educational Psychology*, *79*, 474-482.

Butterfield, S. A., Angell, R. M., & Mason, C. A. (2012). Age and gender differences in object control skills by children ages 5 to 14. *Perceptual and motor skills, 76*, 459-464.

Butterfield, S. A., & Loovis, E. M. (1993). Influence of age, sex, balance, and sport participation on development of throwing by children in grades K-8. *Perceptual and Motor Skills*, *76*, 459-464.

Capio, C. M., Poolton, J. M., Sit, C. H. P., Holmstrom, M., & Masters, R. S. W. (2013). Reducing errors benefits the field-based learning of a fundamental movement skill in children. *Scandinavian Journal of Medicine & Science in Sports*, *23*, 181-188.

Carpenter, P. J., & Morgan, K. (2000). Motivational climate, personal goal perspectives, and cognitive and affective responses in physical education classes. *European Journal of Physical Education*, *4*, 31-44.

Chen, W., Mason, S., Hypnar, A., & Bennett, A. (2016). Assessing motor skill competency in elementary school students: A three-year study. *Journal of Sports Science & Medicine*, *15*, 102-110.

Clark, J.E. (1994). Motor development. In V.S. Ramachandran (Ed.), *Encyclopedia of human behavior* (3rd ed., pp. 245-255). San Diego, CA: Academic Press.

Clark, J. E. (2005). From the beginning: a developmental perspective on movement and mobility. *Quest*, *57*, 37-45.

Clark, J. E., & Metcalfe, J. S. (2002). The mountain of motor development: A metaphor. *Motor Development: Research and Reviews*, *2,* 163-190.

Cohen, R., Goodway, J. D., & Lidor, R. (2012). The effectiveness of aligned developmental feedback on the overhand throw in third-grade students. *Physical Education and Sport Pedagogy*, *17*, 525-541.

Corno, L., & Rohrkemper, M. (1985). The intrinsic motivation to learn in the classroom. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 2, pp. 53-90). New York: Academic Press.

Cury, F., Biddle, S., Famose, J., Goudas, M., Sarrazin, P., & Durand, M. (1996). Personal and situational factors influencing intrinsic motivation of adolescent girls in 101 school physical education: A structural equation modeling analysis. *Educational Psychology*, *16*, 305-315.

Deli, E., Bakle, I., & Zachopoulou, E. (2006). Implementing intervention movement programs for kindergarten children. *Journal of Early Childhood Research*, *4*(1), 5-18.

DiRocco, P., & Roberton, M. A. (1981). Implications of motor development research: The overarm throw in the mentally retarded. *Physical Educator*, *38*, 27-31.

Duda, J. L., Fox, K. R., Biddle, S. J., & Armstrong, N. (1992). Children's achievement goals and beliefs about success in sport. *The British Journal of Educational Psychology*, *62*, 313-323. doi:10.1111/j.2044-8279.1992.tb01025.x

Duda, J. L., & White, S. A. (1992). Goal orientations and beliefs about the causes of success among elite skiers. *The Sport Psychologist*, *6*, 334-343.

Dunn, J. C. (2000). Goal orientation, perceptions of the motivational climate, and perceived competence of children with movement difficulties. *Adapted Physical Activity Quarterly*, *17*, 1-19.

Dusenberry, L. (1952). A study of the effects of training in ball throwing in children ages three to seven. *Research Quarterly*, *23*, 9-14.

Dweck, C., & Leggett, E. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, *95*, 256-273. doi:10.1037/0033-295X.95.2.256

East, W. B., & Hensley, L. D. (1985). The effects of selected sociocultural factors upon the overhand-throwing performance of prepubescent children. *Motor Development: Current selected Research*, *1*, 115-127.

Dweck, C., & Elliott, E. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54 (1), 5-12.

Epstein, J. (1988). Effective schools or effective students? Dealing with diversity. In R. Hawkins & B. MacRae (Eds.), *Policies for America's public schools* (pp. 89–126). Norwood, NJ: Ablex.

Epstein, J. (1989). Family structure and students motivation: A development perspective. In C. Ames & R. Ames (Eds.), *Research on motivation in education (*Vol. 3, pp. 259–295). New York: Academic Press.

Erwin, H. E., & Castelli, D. M. (2008). National physical education standards: a summary of student performance and its correlates. *Research Quarterly for Exercise and Sport*, *79*, 495-505.

Fisher, A., Reilly, J. J., Kelly, L. A., Montgomery, C., Williamson, A., Paton, J. Y., & Grant, S. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine & Science in Sports & Exercise*, *37*, 684-688.

Fox, K., Goudas, M., Biddle, S., Duda, J., & Armstrong, N. (1994). Children's task and ego goal profiles in sport. *The British Journal of Educational Psychology*, *64*, 253-261. doi:10.1111/j.2044- 8279.1994.tb01100.x

Fronske, H., Blakemore, C. L., & Abendroth-Smith, J. (1997). The effect of critical cues on overhand throwing efficiency of elementary school children. *The Physical Educator*, *54*, 88-95.

Gabbard, C. P. (2011). *Lifelong motor development*. City: Pearson Higher Ed.

Gagen, L., & Getchell, N. (2004). Combining theory and practice in the gymnasium: Constraints within an ecological perspective. *Journal of Physical Education, Recreation and Dance*, *75*(5), 25-30.

Gagen, L., & Getchell, N. (2008). Applying Newton's apple to elementary physical education. Journal of Physical Education, Recreation and Dance, *79*(8), 43-51.

Gallahue, D. L., & Donnelly, F. C. (2007). *Developmental physical education for all children*. Human Kinetics.

Gallahue, D. L., & Ozmun, J. C. (1998). *Understanding motor development: Infants, children, adolescents, adults*. City: McGraw-Hill Humanities, Social Sciences & World Languages.

Gallahue, D. L., Ozmun J. C., & Goodway, J. D. (2012). *Understanding motor development: infants, children, adolescents, adults*. New York: McGraw-Hill.

Garcia, C., & Garcia, L. (2002). Examining developmental changes in throwing. In J. E. Clark & J. H. Humphrey Lorson.indd 181 6/2/2008 2:26:34 PM 182 RQES: June 2008 Lorson and Goodway (Eds.), *Motor development: Research and review*: Vol. 2 (pp. 62–95). Reston, VA: NASPE Publications.

Goodway, J. D., & Branta, C. F. (2003). Influence of a motor skill intervention on fundamental motor skill development of disadvantaged preschool children. *Research Quarterly for Exercise and Sport*, *74*, 36-46.

Goodway, J. D., Crowe, H., & Ward, P. (2003). Effects of motor skill instruction on fundamental motor skill development. *Adapted Physical Activity Quarterly*, *20*, 298-314.

Goodway, J. D., Robinson, L. E., & Crowe, H. (2010). Gender differences in fundamental motor skill development in disadvantaged preschoolers from two geographical regions. *Research Quarterly for Exercise and Sport*, *81*, 17-24.

Goodway, J. D., & Rudisill, M. E. (1997). Perceived physical competence and actual motor skill competence of African American preschool children. *Adapted Physical Activity Quarterly*, *14*, 314-326.

Goudas, M. (1998). Motivational climate and intrinsic motivation of young basketball players. *Perceptual and Motor Skills, 86*, 323-327.

Halverson, L. E., & Roberton, M. A. (1979). The effects of instruction on overhand throwing development in children. In G. Roberts & K. Newell (Eds.), *Psychology of motor behavior and sport* (pp. 258-269). Champaign, IL: Human Kinetics.

Halverson, L. E., Roberton, M. A., & Langendorfer, S. (1982). Development of the overarm throw: Movement and ball velocity changes by seventh grade. *Research Quarterly for Exercise and Sport*, *53*, 198-205.

Halverson, L. E., Roberton, M. A., Safrit, M. J., & Roberts, T. W. (1977). The effect of guided practice on overhand throw ball velocities of kindergarten children. *Research Quarterly*, *48*, 311-318.

Hamilton, M., Goodway, J., & Haubenstricker, J. (1999). Parent-assisted instruction in a motor skill program for at-risk preschool children. *Adapted Physical Activity Quarterly*, *16*, 415-426.

Hamilton, M., Liu, T., & ElGarhy, S. (2017). The relationship between body weight and motor skill competence in Hispanic low-SES preschool children. *Early Childhood Education Journal*, *45*, 529-535.

Hamilton, M. L., & Tate, A. (2002). Constraints on throwing behavior of children. In J. E. Clark & J. H. Humphrey (Eds.), *Motor development: Research and review*: Vol. 2 (pp. 49-61). Reston, VA: NASPE Publications.

Hardy, L. L., Reinten-Reynolds, T., Espinel, P., Zask, A., & Okely, A. D. (2012). Prevalence and correlates of low fundamental movement skill competency in children. *Pediatrics*, *130*, 390-398.

Harris, R. J. (2001). *A primer of multivariate statistics*. City: Psychology Press.

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

Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. *Developmental Psychology*, *17*, 300-xxx.

Harter, S., Whitesell, N. R., & Kowalski, P. (1992). Individual differences in the effects of educational transitions on young adolescent's perceptions of competence and motivational orientation. *American Educational Research Journal*, *29*, 777-807.

Hastie, P.A., Johnson, J., & Rudisill, M. E. (2018). An analysis of the attraction and holding power of motor skill stations used in a mastery motivational physical education climate for preschool children. *Physical Education and Sport Pedagogy, 23*, 37-53.

Hastie, P. A., Rudisill, M. E., & Boyd, K. (2016). An ecological analysis of a preschool mastery climate physical education programme. *Physical Education and Sport Pedagogy*, *21*, 217-232. doi://10.1080/17408989.2015.1017454

Hastie, P. A., Rudisill, M. E., & Wadsworth, D. D. (2013). Providing students with voice and choice: Lessons from intervention research on autonomy-supportive climates in physical education. *Sport Education and Society*, *18*, 38-56. doi:10.1080/13573322.2012.701203

Haubenstricker, J., Branta, C., & Seefeldt, V. (1983). Preliminary validation of developmental sequences for throwing and catching. In Proceedings of the *Annual Conference of the North American Society for the Psychology of Sport and Physical Activity,* East Lansing, MI.

Hauser-Cram, P. (1998). I think I can, I think I can: Understanding and encouraging mastery motivation in young children*.* *Young Children*, *53*, 67-71.

Hauser-Cram, P., & Shonkoff, J. P. (1995). Mastery motivation: Implications for interventions. *Mastery motivation: Origins, conceptualizations, and applications*, 257-272. Norwood, NJ: Ablex.

Haywood, K.M., & Getchell, N. (2014). *Life span motor development* (6th ed.) Champaign, IL: Human Kinetics.

Herbert, E. (in press). The effect of observing a learning model (or two) on motor skill acquisition. *Journal of Motor Learning and Development*, doi: 10.1123/jmld.2016-0037

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise*, *15*, 382-391.

Houwen, S., Visscher, C., Lemmink, K. A. P. M., & Hartman, E. (2008). Motor skill performance of school-age children with visual impairments. *Developmental Medicine & Child Neurology*, *50*, 139-145.

Hyde, J. S. (2005). The gender similarities hypothesis. *American Psychologists*, *60*(6), 581-592.

Ignico, A. A. (1991). Effects of a competency-based instruction on kindergarten children's gross motor development. *Physical Educator*, *48*, 188-191.

Jaakkola, T., Yli-Piipari, S., Huotari, P., Watt, A., & Liukkonen, J. (2016). Fundamental movement skills and physical fitness as predictors of physical activity: A 6-year follow-up study. *Scandinavian Journal of Medicine and Science in Sports*, *26*, 74-81.

Kachigan, S. K. (1991). *Multivariate statistical analysis: A conceptual introduction*. City: Radius Press.

Kaplan, A., & Maehr, M. L. (1999). Achievement goals and student well-being. *Contemporary Educational Psychology*, *24*, 330-358.

Kavussanu, M., & Roberts, G. (1996). Motivation in physical activity contexts: The relationship of perceived motivational climate to intrinsic motivation and self-efficacy. *Journal of Sport and Exercise Psychology*, *18*, 264-280.

Langendorfer, S. (1982). *Developmental relationships between throwing and striking: A prelongitudinal test of motor stage theory*. Unpublished doctoral dissertation, University of Wisconsin, Madison.

Langendorfer, S., & Roberton, M. A. (2002a). Individual pathways in the development of forceful throwing. *Research Quarterly for Exercise and Sport*, 73(3) 245-256.

Lee, T. D., Chamberlin, C. J., & Hodges, N. (2001). Practice. In R. N. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed.) (pp. 115–143). New York: John Wiley.

Lloyd, J., & Fox, K. (1992). Achievement goals and motivation to exercise in adolescent girls: A preliminary intervention study. *British Journal of Physical Education Research Supplement*, *11*, 12-16.

Logan, S. W., Barnett, L. M., Goodway, J. D., & Stodden, D. F. (2016). Comparison of performance on process- and product-oriented assessments of fundamental motor skills across childhood. *Journal of Sports Sciences, 35,* 634-641.

Logan, S. W., Robinson, L. E., Webster, E. K., & Rudisill, M. E. (2015). The influence of instructional climates on time spent in management tasks and physical activity of 2nd-grade students during physical education. *European Physical Education Review*, *21*, 195-205.

Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2012). Getting the fundamentals of movement: a meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development*, *38*, 305-315.

Lorson, K. M., & Goodway, J. D. (2007). Influence of critical cues and task constraints on overarm throwing performance in elementary age children. *Perceptual and Motor Skills*, *105*, 753-767.

Lorson, K. M., & Goodway, J. D. (2008). Gender differences in throwing form of children ages 6–8 years during a throwing game. *Research Quarterly for Exercise and Sport*, *79*, 174-182.

Maehr, M. L. (1983). On doing well on science. Why Johnny no longer excels, why Sarah never did. In S. G. Paris, G. M. Olson, and H. W. Stevenson (Eds.), *Learning and motivation in the classroom* (pp. 179-210). Hillsdale, NJ: Lawrence Erlbaum and Associates.

Maehr, M. L. (1984). Meaning and motivation: Toward a theory of personal investment. In R. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol. 1, pp. 115-144). New-York: Academic Press.

Maehr, M. L., & Zusho, A. (2009). Achievement goal theory: The past, present, and future. In K. R. Wentzel & A. Wigfield (eds.), *Handbook of motivation at school* (pp. 77 – 104). New York: Routledge.

Malina, R. M., & Bouchard, C. (1991). *Growth, maturation, and physical activity.* Champaign, IL: Human Kinetics.

Martin, E. H., Rudisill, M. E., & Hastie, P. A. (2009). The effectiveness of a mastery motivational climate motor skill intervention in a naturalistic physical education setting. *Physical Education and Sport Pedagogy*, *14*, 227-240. doi:10.1080/17408980801974952

Morgan, G. A., Harmon, R. J., & Maslin-Cole, C. A. (1990). Mastery motivation: Definition and measurement. *Early Education and Development*, *1*, 318-339. doi:10.1207/s15566935eed0105_1

Morgan, G. A., MacTurk, R. H., & Hrncir, E. J. (1995). Mastery motivation: Overview, definitions and conceptual issues. In R.H. MacTurk & G.A. Morgan (Eds.), *Mastery motivation: Origins, conceptualizations, and applications* (pp. 1-18). Norwood, NJ: Ablex.

Morgan, G. A., Maslin-Cole, C. A., Harmon, R. J., BuschRossnagel, N. A., Jennings, K. D., Hauser-Cram, P., & Brockman, L. (1993). Parent and teacher perceptions of young children's mastery motivation: Assessment and review of research. In D. Messer (Ed.), *Mastery motivation in early childhood: Development, measurement and social processes* (pp. 109-131). London: Routledge.

Morgan, P. J., Okely, A. D., Cliff, D. P., Jones, R. A., & Baur, L. A. (2008). Correlates of objectively measured physical activity in obese children. *Obesity*, *16*, 2634-2641.

Morgan, G. A., & Yang, R. K. (1995). Toward a multifaceted conceptualization of mastery motivation and an organized summary of research. In R.H. MacTurk & G.A. Morgan (Eds.), *Mastery motivation: Origins, conceptualizations, and applications* (pp. 317-337). Norwood, NJ: Ablex.

Nelson, K., Thomas, J., & Nelson, J. (1991). Longitudinal change in throwing performance: Gender differences. *Research Quarterly for Exercise and Sport*, *62*, 105-108.

Nelson, J. K., Thomas, J. R., Nelson, K. R., & Abraham, P. (1986). Gender differences in children's throwing performance: Biology and environment. *Research Quarterly for Exercise and Sport*, *57*, 280-287.

Newell, K. (1984). Physical constraints to development of motor skills. In J. Thomas (Ed.), *Motor development during preschool and elementary* years (pp. 105-120). Minneapolis: Burgess.

Newsham, S. L. (1989). The effects of a task-oriented physical education program on the self-perception of third, fourth, and fifth grade students. *Dissertation Abstracts International*, *50*(06), 2631B. (UMI No. 8921305)

Nicholls, J. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review*, *91*, 328-346. doi:10.1037/0033-295X.91.3.328

Nicholls, J. G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press

Ntoumanis, N., & Biddle, S. J. H. (1999a). Affect and achievement goals in physical education: A meta-analysis. *Scandinavian Journal of Medicine and Science in Sports,* 9, 315-332.

Ntoumanis, N., & Biddle, S. J. H. (1999b). A review of motivational climate in physical activity. *Journal of Sports Sciences, 17*, 643-665.

Obrusnikova, I., & Cavalier, A. (2017). An evaluation of videomodeling on fundamental motor skill performance of preschool children. *Early Childhood Education Journal.* doi: 10.1007/s10643-017-0861-y

Okely, A. D., & Booth, M. L. (2004). Mastery of fundamental movement skills among children in New South Wales: prevalence and sociodemographic distribution. *Journal of Science and Medicine and Sport, 7,* 358-372.

Okely, A. D., Booth, M. L., & Patterson, J. W. (2001a). Relationship of physical activity to fundamental movement skills among adolescents. *Medicine and Science in Sports and Exercise*, *33*, 1899-1904.

Ommundsen, Y., Roberts, G. C., & Kavussanu, M. (1998). Perceived motivational climate and cognitive and affective correlates among Norwegian athletes. *Journal of Sport Sciences, 16*, 153-164.

Papaioannou, A., & Kouli, O. (1999). The effect of task structure, perceived motivational climate, and goal orientations on student's task involvement and anxiety. *Journal of Applied Sport Psychology*, *11*, 51-71.

Parish, L. E., St. Onge, P. M., Rudisill, M. E., Weimar, W., & Wall, S. J. (2005). Mastery motivational motor skills program: Influence on heart rate and physical activity levels in toddlers (Abstract). *Journal of Sport & Exercise Psychology*, *27*, S121.

Parish, L.E., & Rudisill, M.E. (2014). Engaging young children in physical activity: Implementing effective theoretically-driven and research-based interventions. In N.C. Valentini & J. R. Krebs (Eds.), *Intervention and Assessment: Designing Studies for Children and Adolescent* (pp. 37–49). Port Alegre, Rio Grande do Sul: Artmed editora.

Parish, L. E., Rudisill, M. E., & St. Onge, P. M. (2007). Mastery motivational climate: Influence on physical play heart rate and intensity in African American toddlers. *Research Quarterly for Exercise and Sport*, *78*, 171-178.

Parish, L. E., & Treasure, D. C. (2003). Physical activity and situational motivation in physical education: Influence of the motivational climate and perceived ability. *Research Quarterly for Exercise and Sport*, *74*, 173-182.

Payne, V. G., & Isaacs, L. D. (2017). *Human motor development: A lifespan approach*. City: Routledge.

Preacher, K. J., & MacCallum, R. C. (2003). Repairing Tom Swift's electric factor analysis machine. *Understanding statistics: Statistical issues in Psychology, Education, and the Social Sciences*, *2*(1), 13-43.

Raffini, J. P. (1993). *Winners without losers: Structure and strategies for increasing student motivation to learn.* Boston, MA: Allyn and Bacon.

Raudsepp, L., Liblik, R., & Hannus, A. (2002). Children's and adolescents' physical self-perceptions as related to moderate to vigorous physical activity and physical fitness. *Pediatric Exercise Science, 14,* 97-106.

Raudsepp, L., & Päll, P. (2006). The Relationship Between Fundamental Motor Skills and Outside-School Physical Activity of Elementary School Children. *Pediatric Exercise Science*, *18*(4), 426-435.

Roberton, M. A. (1977). Stability of stage categories across trials: implications of stage theory of overarm throwing development. *Journal of Human Movement Studies*, *3*, 49-59.

Roberton, M. A. (1978a). Longitudinal evidence for developmental stages in the forceful overarm throw. *Journal of Human Movement Studies*, *4*, 167-175.

Roberton, M. A. (1984). Changing motor patterns during childhood. In J.R. Thomas (Ed.), *Motor development during childhood and adolescence* (pp. 48-90). Minneapolis, MN: Burgess.

Roberton, M. A., & Di Rocco, P. (1981). Validating a motor skill sequence for mentally retarded children. *American Corrective Therapy Journal*, *35*(6), 148-154.

Roberton, M. A., & Halverson, L. E. (1984). *Developing children -Their changing movement.* Philadelphia: Lea & Febiger.

Roberton, M. A., Halverson, L. E., Langendorfer, S., & Williams, K. (1979). Longitudinal changes in children's overarm throw ball velocities. *Research Quarterly for Exercise & Sport, 50*(2), 256-264.

Roberton, M. A., & Konczak, J. (2001). Predicting children's overarm throw ball velocities from their developmental levels in throwing. *Research Quarterly for Exercise & Sport*, *7*, 91-103.

Roberton, M. A., & Langendorfer, S.]. (1980). Testing motor development sequences across 9-14 years. In C. Nadeau, W. Halliwell, K. Newell, & G. Roberts (Eds.), *Psychology of motor behavior and sport-1979 (*pp. 269-279). Champaign, IL: Human Kinetics.

Robinson, L. E. (2011). Effect of a mastery climate motor program on object control skills and perceived physical competence in preschoolers. *Research Quarterly for Exercise and Sport*, *82*, 355-359.

Robinson, L. E., & Goodway, J. D. (2009). Instructional climates in preschool children who are at-risk. Part I: Object-control skill development. *Research Quarterly for Exercise and Sport*, *80*, 533-542.

Robinson, L. E., Rudisill, M. E., & Goodway, J. D. (2009). Instructional climates in preschool children who are at-risk. Part II: Perceived physical competence. *Research Quarterly for Exercise and Sport*,*80*, 543-551.

Robinson, L. E., Wadsworth, D. D., & Peoples, C. M. (2012). Correlates of school-day physical activity in preschool students. *Research quarterly for exercise and sport*, *83*, 20-26.

Rovegno, I., & Bandhauer, D. (2016). *Elementary physical education*. Jones & Bartlett Learning.

Rudisill, M. E. (1989a). Influence of self-concept of ability and causal dimension orientations on intrinsic motivation, performance, and expectations of performance during perceived failure. *Research Quarterly for Exercise and Sport*, *60*, 166-175.

Rudisill, M. E. (1989b). The influence of various achievement goal orientations on perceived competence and the attributional process. *Journal of Human Movement Studies*, *16*, 55-73.

Rudisill, M. E. (1991). The influence of various achievement goal orientations of children's perceived competence and the attributional process. *Journal of Human Movement Studies*, *18*, 44-61.

Salehi, S. K., Sheikh, M., & Talebrokni, F. S. (2017). Comparison exam of Gallahue's hourglass model and Clark and Metcalfe's the mountain of motor development metaphor. *Advances in Physical Education*, *7*(3), 217-233.

Schmidt, R. A., & Lee, T. D. (2005). *Motor control and learning: A behavioral emphasis* (4th ed.). Champaign, IL: Human Kinetics.

Seefeldt, V. (1980). Developmental motor patterns: Implications for elementary school physical education. *Psychology of Motor Behavior and Sport*, *36*, 314-323.

Seifriz, J. J., Duda, J. L., & Chi, L. (1992). The relationship of perceived motivational climate to intrinsic motivation and beliefs about success in basketball. *Journal of Sport and Exercise Psychology*, *14*, 375-391.

Siedentop, D., Tousignant, M. and Parker, M. 1982. *Academic Learning Time-Physical Education: Coding Manual*, (2nd edn), Columbus, OH: The Ohio State University.

Silverman, S. (1985). Relationship of engagement and practice trials to student achievement. *Journal of Teaching in Physical Education*, *5*, 13-21.

Solmon, M.A., & Boone, J. (1993). The impact of student goal orientation in physical education classes. *Research Quarterly for Exercise and Sport, 64*, 418-424. doi:10.1080/02701367.1993.10607595

Spray, C.M., Biddle, S.J.H., & Fox, K.R. (1999). Achievement goals, beliefs about the causes of success, and report emotion in post-16 physical education. *Journal of Sports Sciences, 17*, 213-219. doi:10.1080/026404199366118

State of Alabama Department of Human Resources. (2006). *Minimum standards for day care centers and nighttime centers: Regulations and procedures.* Retrieved April 25, 2018, from http://www.dhr.state.al.us/Search.asp

Stodden, D. F. (2002). Developmental aspects of the overhand throw: Comparison of instructional interventions on throwing performance characteristics. PhD diss., Auburn University.

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, *60*, 290-306.

Stodden, D.F., Langendorfer, S.J., Fleisig, G.S., & Andrews, J.R. (2006a). Kinematic constraints associated with the acquisition of overarm throwing Part I: Step and trunk actions. *Research Quarterly for Exercise and Sport*, *77*, 417-427.

Stodden, D.F., Langendorfer, S.J., Fleisig, G.S., & Andrews, J.R. (2006b). Kinematic constraints associated with the acquisition of overarm throwing Part II: Upper extremity actions. *Research Quarterly for Exercise and Sport, 77*, 428-436.

Stodden, D., Langendorfer, S., & Roberton, M. A. (2009). The association between motor skill competence and physical fitness in young adults. *Research quarterly for exercise and sport*,*80*, 223-229.

Stodden, D. F., & Rudisill, M. E. (2006). Integration of biomechanical and developmental concepts in the acquisition of throwing: Effects on developmental characteristics and gender differences. *Journal of Human Movement Studies, 51,* 117-141.

Theeboom, M., De Knop, P. D., & Weiss, M.R. (1995). Motivational climate, psychological responses, and motor skill development in children's sport: A fieldbased intervention study. *Journal of Sport Psychology*, *17*, 294-311.

Theodosiou, A., Mantis, K., & Papaioannou, A. (2008). Student self-reports of metacognitive activity in physical education classes. Age-group differences and the effect of goal orientations and perceived motivational climate. *Educational Research and Reviews*, *3*, 353-364.

Thomas, J. R., Alderson, J. A., Thomas, K. T., Campbell, A. C., & Elliott, B. C. (2010). Developmental gender differences for overhand throwing in aboriginal Australian children. *Research Quarterly for Exercise and Sport, 81,* 432-441.

Thomas, J. R., & French, K. E. (1985). Gender differences across age in motor performance: A meta-analysis. *Psychological Bulletin*, *98*, 260-282.

Thomas, J. R., Michael, D., & Gallagher, J. D. (1994). Effects of training on gender differences in overhand throwing: a brief quantitative literature analysis. *Research Quarterly for Exercise and Sport*, *65*, 67-71.

Thomas, J. R., & Thomas, K. T. (1988). Development of gender differences in physical activity. *Quest,40*, 219-229.

Tompsett, C., Sanders, R., Taylor, C., & Cobley, S. (2017). Pedagogical approaches to and effects of fundamental movement skill interventions on health outcomes: A systematic review. *Sports Medicine*, *47*(9), 1795-1819.

Treasure, D. C. (1997). Perceptions of the motivational climate and elementary school children's cognitive and affective response. *Journal of Sport & Exercise Psychology*, *19*, 278-290.

Treasure, D. C., & Roberts, G. C. (2001). Students' perceptions of the motivational climate, achievement beliefs, and satisfaction in physical education. *Research Quarterly for Exercise and Sport, 72*, 165-175. doi:10.1080/02701367.2001.10608946

Ulrich, D. A. 2000. *Test of Gross Motor Development II*. Austin, TX: PRO-ED.

Ulrich, D. A. (2013). The test of gross motor development-3 (TGMD-3): Administration, scoring, and international norms. *Spor Bilimleri Dergisi*, *24*(2), 27-33.

Valentini, N. C., Pierosan, L., Rudisill, M. E., & Hastie, P. A. (2017). Mastery and exercise play interventions: motor skill development and verbal recall of children with and without disabilities. *Physical Education and Sport Pedagogy*, *22*, 349-363.

Valentini, N. C., & Rudisill, M. E. (2004a). An inclusive mastery climate intervention and the motor skill development of children with and without disabilities. *Adapted Physical Activity Quarterly*, *21*, 330-347.

Valentini, N. C., & Rudisill, M. E. (2004b). Motivational climate, motor-skill development, and perceived competence: Two studies of developmentally delayed kindergarten children. *Journal of Teaching in Physical Education*, *23*, 216-234.

Wadsworth, D. D., Robinson, L. E., Rudisill, M. E., & Gell, N. (2013). The effect of physical education climates on elementary students' physical activity behaviors. *The Journal of School Health, 83*, 306-313. doi:10.1111/josh.12032

Wadsworth, D. D., Rudisill, M. E., Hastie, P. A., Boyd, K. L., & Rodríguez-Hernández, M. (2014). Preschoolers´ physical activity and time on task during a mastery motivational climate and free play. *MHSalud*, *11*(1). pages

Wall, S. J., Rudisill, M. E., & Gladden, L. B. (2009). Cortisol response to physical activity in African American toddlers attending full-time day care. *Research Quarterly for Exercise and Sport*, *80*(4), 739-746. doi:10.1080/02701367.2009.10599615

Wall, S. J., Rudisill, M. E., Parish, L., & Goodway, J. D. (2004). A comparison of three movement settings on the development of fundamental motor skills in young children [Abstract]. *Journal of Sport & Exercise Psychology*, *26*, S-194.

Walling, M. D., Duda, J. L., & Chi, L. (1993). The perceived motivational climate in sport questionnaire: Construct and predictive validity. *Journal of Sport & Exercise Psychology*, *15*, 172-183.

White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, *66*, 297-333. doi:10.1037/h0040934

Wigfield, A., Eccles, J.S., & Rodriguiz, D. (1998). The development of children's motivation in school contexts. In P.D. Pearson & A. Iran-Nejad (Eds.), *Review of research in education* (Vol. 23, pp. 73– 118). Washington, DC: American Educational Research Association. doi:10.2307/1167288

Williams, K., Haywood, K. M., & Painter, M. A. (1996). Environmental versus biological influences on gender differences in the overarm throw for force: Dominant and nondominant arm throws. *Women in Sport and Physical Activity Journal, 5,* 29-48.

Yoo, J. (1999). Motivational-behavioral correlates of goal orientation and perceived motivational climate in physical education contexts. *Perceptual and Motor Skills*, *89*, 262-274.

Yoo, J. (2003). Motivational climate and perceived competence in anxiety and tennis performance. *Perceptual and Motor Skills*, *96*, 403-413. doi:10.2466/pms.2003.96.2.403

Institutional Review Board Approval

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS

REQUEST for PROJECT RENEWAL

For Information or help completing this form, contact: **THE OFFICE OF RESEARCH COMPLIANCE (ORC)**, 115 Ramsay Hall
Phone: 334-844-5966 **e-mail:** IRBAdmin@auburn.edu **Web Address:** http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2.1.2014 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Exempt Activities: Must be renewed at least every 3 years.

Expedited and Full Board Protocols: Must be renewed at least annually, prior to the expiration date of the protocol.

If you do not plan to collect additional data and/or you do not have access to identifiable data (code lists, etc.), you may be able to file a "FINAL REPORT" for this project. Contact the ORC for more information.

Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

1. **Protocol Number:** 06-262 EP 0701
2. **Original IRB Approval Dates:** From: 1/29/2007 To: 12/11/2017
3. **Requested Renewal Period (ONE YEAR MAXIMUM):** From: 12/11/2017 To: 12/11/2018
4. **PROJECT TITLE:** The influence of Mastery Motivational Climates on the Physiological Parameters of ~~Young Children~~
5.

PRINCIPAL INVESTIGATOR	TITLE	DEPT	PHONE	AU E-MAIL
Mary Rudisill	Director	Kinesiology	334-844-1458	rudisme@auburn.edu

PI SIGNATURE	MAILING ADDRESS	ALTERNATE E-MAIL
[signature]	301 Wire Rd., Sch of Kinesiology	

FACULTY ADVISOR	SIGNATURE	DEPT	PHONE	AU E-MAIL

Name of Current Department Head: Mary Rudisill AU E-MAIL: rudisme@auburn.edu

6. **Current External Funding Agency and Grant number:** n/a

7. **a. List any contractors, sub-contractors, other entities associated with this project:**
n/a

b. List any other IRBs associated with this project: n/a

8. **Explain why you are requesting additional time to complete this research project.**
I am interested in the effects of a year-long mastery motivational physical education intervention on young children's motor skill development, perceptions of competence, and physical activity. Currently, we are having to complete 3 - 5 interventions to have enough participants to complete Project 1 study. We are also learning about how to better assess motor skills and motor skill perceived competence.

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC: ______ by ______ RENEWAL #
DATE OF IRB REVIEW: ______ by ______ PROTOCOL #
DATE OF IRB APPROVAL: ______ by ______ INTERVAL FC
COMMENTS:

The Auburn University Institutional Review Board has approved this Document for use from 11/29/2017 to 12/11/2018
Protocol # 06-262 EP 0701

9. **Briefly list** *(numbered or bulleted)* **the activities that occurred over the past year, particularly those that involved participants.**

Project 1: Assessed children's motor skill competence, perceptions of competence, and cognitive function with preschoolers at Darden Head Start. Participants participated in a motor development program emphasizing physical activity and motor skill learning.

Project 2: Assessed children/youth descriptive information, motor skill competence and cognitive assessments in the Pediatric Movement and Physical Activity Lab.

10. **Do you plan to make any changes in your protocol if the renewal request is approved?**
(e.g., research design, methodology, participant characteristics, authorized number of participants, etc.)

○ NO ◉ YES

(If "yes", please complete and attach a "REQUEST for PROTOCOL MODIFICATION" form.)

11. **PARTICIPANT INFORMATION**

a. **How many individuals have actually participated in this research?** 218 (1024 Previous)
If retrospective, how many files or records were accessed? n/a

b. **Were there any adverse events, unexpected difficulties or unexpected benefits with the approved procedures?**

◉ NO ○ YES

If YES, please describe.

d. **How many participants have withdrawn from the study?** 5 ☐ NA
If participants withdrew from the study, please explain.

Project 1: Five children withdrew from Darden Head Start program. Since they withdrew, they stopped participating in our motor development program.

Project 2: n/a

e. **How many new participants do you plan to recruit during the renewal period?** 100 ☐ NA

f. **During the renewal period, will you re-contact any individual that has already participated in your research project?**

☑ NA

◉ NO ○ YES

If "YES", please explain reasons for re-contacting participants. (If "YES" and the procedure to re-contact has not been previously approved, please complete and attach a "REQUEST for PROTOCOL MODIFICATION" form.)

12. PROTECTION OF DATA

a. Is the data being collected, stored and protected as previously approved by the IRB?

☐ NO ☒ YES

If NO, please explain.

b. Are there any changes in the "key research personnel" that have access to participants or data?
Attach CITI completion reports for all new key personnel.

☒ NO ☐ YES

If YES, please identify each individual and explain the reason(s) for each change.

c. What is the latest date (month and year) you now expect all identifiable data to be destroyed?
(Identifiable data includes videotapes, photographs, code lists, etc.)

DATE: 12/11/2019 ☐ Not Applicable – no identifiable data has been or will be collected.

11. Attach a copy of all "stamped" IRB-approved documents used during the previous year.
(Information letters, Informed Consents, Parental Permissions, flyers etc.).

12. **If you plan to recruit participants, or collect human subject data during the renewal period,** attach a new copy of the consent document, information letter, or any flyers **you will use during the extension.**

(Be sure to review the ORC website for current consent document guidelines and updated contact information: http://www.auburn.edu/research/vpr/ohs/sample.htm .)

AUBURN COUNCIL ON HUMAN REALTIONS, INC.

CHILD DEVELOPMENT PROGRAM

P.O. BOX 3770/950 Shelton Mill Road Auburn, AL 36831 – 3770

Phone (334) 821 – 8336 FAX (334) 826-6397 Email alma.gholston@achr.com

FAMILY NOTICE!

DARDEN'S EXCITING CONTINUED HEAD START

PARTNERSHIP WITH AUBURN UNIVERSITY DEPARTMENT OF KINESIOLOGY

8-22-17

With the agreement of our Parent Policy Council at ACHR, Darden Head Start Center children & Staff will be participating in a special physical activity program at Darden Center, starting at the end of August.

In this program, children will have the opportunity to gain higher physical and coordination skills as they play and move during their outside time on Tuesdays and Thursdays. The Auburn University Department of Kinesiology will be providing special equipment, activities, and volunteer university students who are studying in the field of Kinesiology (study of human movement) to help with this project. Children's teachers will supervise and participate with the children in these activities.

In order for any data to be collected on your child during this project we need a signed parent permission form. Your child and our staff will gain skills and health benefits from participating in these activities. Data gathered will be used to advance AU's knowledge of young children's movement and how to best encourage children to participate in physical activities. To protect children's privacy, names of children are not used in research findings.

<u>All children will have the opportunity to participate. If you wish to allow your child's data to be included in this research, please read and sign the attached permission form and return it to Darden Center immediately. We cannot start until we receive permission forms.</u>

Appendix C
Informed Consent Form

Auburn University
SCHOOL OF KINESIOLOGY

INFORMED CONSENT FOR DETERMINING THE EFFECTIVENESS OF THE PRESCHOOL MOTOR DEVELOPMENT PROGRAM- ACHR- DARDEN HEAD START CENTER

We invite your child to participate in the Darden Head Start Center Motor Development Program. We are interested in determining the effects motor development programming has on the children's motor skill development, self-perceptions, physical activity and fitness level, mastery motivation, home environment, social and emotional behavior, and cognitive skills. The assessments measure actual motor skill performance (measured by the Test of Gross Motor Development), motor proficiency (measured by the Bruininks' Qseretsky Test of Motor Proficiency), and throwing speed (measured with a velocity speed radar detector), perceptions of physical competence and body image (measured by the Pictorial Scale of Perceived Competence and Acceptance), physical activity level (measured using the System of Observing Fitness Instruction Time, and accelerometers), mastery motivation (measured by the Dimensions of Mastery Questionnaire- 17), home environment (measured with items from the National Children and Youth Fitness Study and the Youth Risk Behavior Survey), social and emotional skills to young children (by accessing and reviewing Head Start Devereux Assessment data and classroom videos) and cognitive skills (measured through the completion of a series of reasoning tasks). Additionally, descriptive information, including height, weight, Body Mass Index, sex, race, and date of birth, will be collected. The assessments will be used for future programming as it relates to Motor Development Programs as well as provide specific instructional information about the progress of your child. All lessons will be video recorded to code the time that children spend practicing. Following is an explanation of each assessment:

Self-perceptions will be assessed with two instruments. *The Pictorial Scale of Perceived Competence and Acceptance* for preschool children will be used to assess perceived competence and acceptance. This assessment consists of 26 items presented on pictorial plates each of which contains two separate pictures, side by side, one of which depicts a child who is skilled, and the other of which depicts a child who is not so skilled. The child's task is to first select the picture that is most like him/herself. Then, after making this choice, the child focuses on that picture and indicates whether he or she is just a little bit like that child or a lot like that child. *Body Perceptions* will also be assessed with black and white line drawing of body figures for children (boys or girls) and for mothers, respectively. Your child will be asked to point to the picture that they perceive "looks most like them, they like the most, and see as healthy for them and their mother".

The *Dimensions of Mastery Questionnaire-17* is used to measure mastery motivation for children from infancy through elementary school-age. This assessment consists of 36 age- appropriate statements about how children perceive their behavior. Children verbally respond to questions regarding their behavior on a scale of 1 'not at all typical' to 4 'very typical'. Children answer questions related to their persistence on motor skills, cognitive tasks, interacting with other children, interacting with adults, and pleasure in learning/mastering skills. Motor skill program teachers will complete a pen and paper version of the Dimensions of Mastery Questionnaire-17.

The *Test of Gross Motor Development* is a measure of fundamental motor skill competence in children ages 3- to 10- years. The 12-item test includes 6 locomotor skills (running, jumping, hopping, leaping, galloping, and sliding) and 6 object-control skills (rolling, throwing, catching, striking, bouncing, and kicking).

301 Wire Road, Auburn, AL 36849-5323; Telephone 334-844-4483; Fax 334"844-1467
www.auburn.edu/kine

The *Bruininks-Oseretsky Test of Motor Proficiency* as an instrument used to measure children's gross and fine motor skills. Specifically the assessment measures: Fine Motor Precision - 7 items (e.g., cutting out a circle, connecting dots); Fine Motor Integration - 8 items (e.g., copying a star, copying a square); Manual Dexterity-5 items (e.g., transferring pennies, sorting cards, stringing blocks), Bilateral Coordination - 7 items (e.g., tapping foot and finger, jumping jacks); Balance-9 items (e.g., walking forward on a line, standing on one leg on a balance beam); Running Speed and Agility - 5 items (e.g., shuttle run, one-legged side hop); Upper-Limb Coordination - 7 items (e.g., throwing a ball at a target, catching a tossed ball); Strength - 5 items (e.g., standing long jump, sit-ups). In addition, children's overhand throwing speed will be measured using a *Velocity Speed Radar Detector.*

The *System of Observing Fitness Instruction Time is* an observational measure used to determine how intense a child is engaged in physical activity. Physical activity intensity level is recorded every 20 seconds. Child physical activity levels are coded on a scale of '1' to '5' corresponding to *the* student's body position: lying down, sitting, standing, walking, or very active.

Accelerometers will be used to assess children's physical activity throughout their day at the childcare center. accelerometers will be attached to the waistband of each child by an investigator prior to participation in the motor development program and/or start of the school day. These devices are small and lightweight (28 x 27 x1 0 mm x 17 g). The accelerometers will measure the body's movement in both the vertical (i.e., up and down) and horizontal (i.e., side to side) direction.

Home environment will be measured using a series of single items designed to measure hypothesized social and physical environmental determinants of physical activity behavior. These will include access to sporting and/or fitness equipment at home (one question on a Likert type scale), access to play areas (two questions on a Likert type scale), and safety (one question on a Likert type scale). These items were modified from measures used in the National Children and Youth Fitness Study and the Youth Risk Behavior Survey.

Social and emotional behavior will be measured by accessing Head Start Devereux Assessment data and video-recorded classroom observations. The Devereux Childhood Assessment (DECA) Preschool Program, 2nd Edition is an assessment used by preschool educators to assist them in teaching social and emotional skills to young children. There are 37 items on the rating scale, each describing a specific behavior. For each child, the teacher indicates the frequency of the behavior's occurrence based on experience with the child. The DECA is currently used within Head Start as a screening tool to identify children who may need additional support in their social and emotional development. Also, the DECA is currently administered several times each year within all Head Start programs, including Darden Head Start in Opelika. The researchers intend to access existing DECA data collected by Darden Head Start over the course of a year for the purpose of monitoring children's social and emotional progress while being exposed to a movement/physical activity program. Accessing Head Start video-recorded classroom observations of instruction will be used to observe children within their classroom settings for the purpose of noting their academic and social behavior before and following the lessons. Currently, Head Start classrooms are equipped with recording devices and classroom activities are recorded for program purposes. The researcher will observe children's behaviors (from the video) before and after their participation in the program. The researchers will watch the recordings and note the frequency of behaviors associated with attention to task, compliance, accuracy of responses to questions, verbal aggression, and physical aggression.

Cognitive Skills will be measured both before and following your child's participation in the movement/ physical activity program and will be assessed through a series of developmentally appropriate cognitive assessments (i.e., The NIH Toolbox cognitive assessments normed for children as young as 3). These include the following: (a) Flanker test takes 4 minutes to administer and measures inhibitory control (how well do children ignore irrelevant stimuli); (b) Processing Speed test takes 3 minutes to administer and measures how quickly can children identify if stimuli are similar or different;

Parent/Guardian initials ___

(c) Dimensional Change Card Sort test takes 4 minutes to complete and measures how well can children shift from one category to another; (d) List Sorting Working Memory test takes 3 minutes to administer and measures how well children can organize a list of animals and food in size order from memory. Cognitive tests will also include: (e) Motor Skill Match test, that takes 4 minutes to complete and measures how quickly can children identify a specific movement skill out of other movements (e.g., kick vs. run, jump, throw); (f) Head, Shoulders, Knees, and Toes test takes 2 minutes to complete and measures how well children can do what they hear and inhibit what they see (e.g., hear head, see shoulders). Parents and teachers of participants will be asked to complete the Children's Independent Learning Development Checklist (5-10 minutes to complete) that will help provide information about the participants' cognitive development.

Descriptive Information including height, weight, Body Mass Index, sex, race, number of siblings, birth order, and date of birth will be gathered for your child. Height will be measured using a standard tape measure. Children will be asked to stand with their back against a wall and height will be measured to the nearest centimeter. Children will also stand on a standard scale to measure their weight to the nearest kilogram. Body Mass Index, a measure of overweight and obesity, will be calculated from the height and weight measures using the formula height divided by weight^2• Parents/guardians will be asked to report their child's sex, race, and date of birth.

There are no foreseeable risks or discomforts associated with completing the Test of Gross Motor Development, completing the Bruininks-Oseretsky Test of Motor Proficiency, reporting self-perceptions, observing physical activity with the System of Observing Fitness Instruction Time, reporting Dimensions of Mastery Questionnaire-17, wearing accelerometers, completing the home environment questionnaire, accessing the DECA data and observing social and emotional behavior, using the velocity speed radar detector to measure speed of throw, and completing the cognitive tasks.

Please note that any child who expresses a desire to quit the assessments will be allowed to stop immediately. Participants will also be told that they can remain in the Motor Development Intervention Program without completing the assessments. To preserve confidentiality, the children's performance and responses will be reported as group results only. I am informing you that any information obtained from the assessments may be used in any way thought best for education and publication. Unless otherwise notified by you, I plan to present the results of this program assessment at a scientific conference and publish the results in an appropriate journal. In any presentation or publication, the data will remain anonymous.

Your decision whether or not to allow your child to participate will not jeopardize his/her future relations with Auburn University, the School of Kinesiology, or Darden Head Start Center. Your child's performance or responses will in no way affect your child's standing in the childcare center. At the conclusion of the assessments, a summary of group results will be made available to all interested parents and. educators. Should you have any questions or desire further information, please contact: Dr. Mary Rudisill at (334) 844-1458 (phone) rudisme@auburn.edu (email). You will be provided a copy of this form to keep.

For more information regarding your rights as a research participant you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@aubum.edu

HAVING READ THE INFORMATION PROVIDED YOU MUST DECIDE WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO ALLOW YOUR CHILD'S PARTICIPATION IN THE STUDY.

Child's Name____

Parent/Guardian Signature____Date ______

Investigator Signature____ Date ______

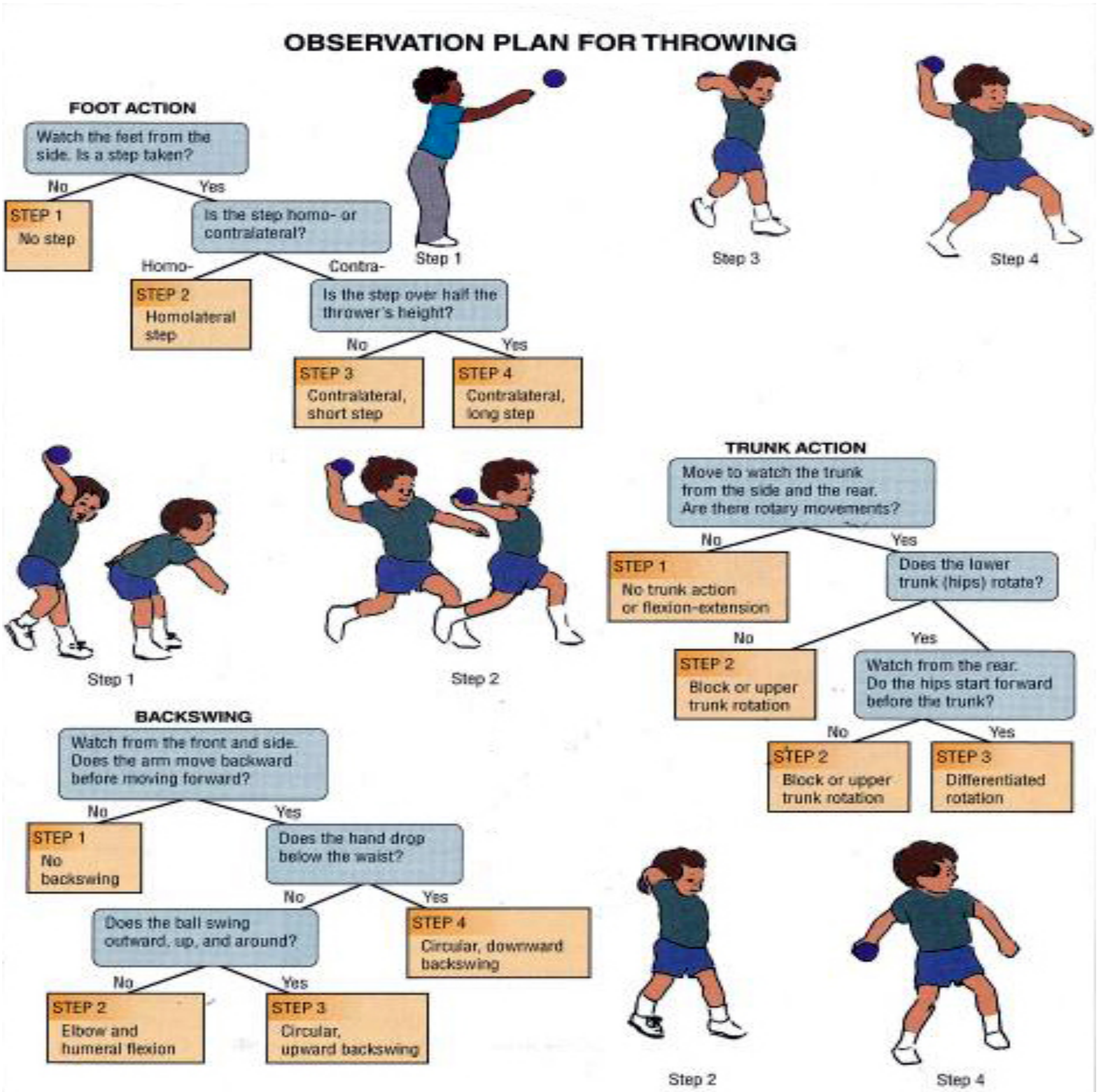
Appendix D: Sample Throwing Stations

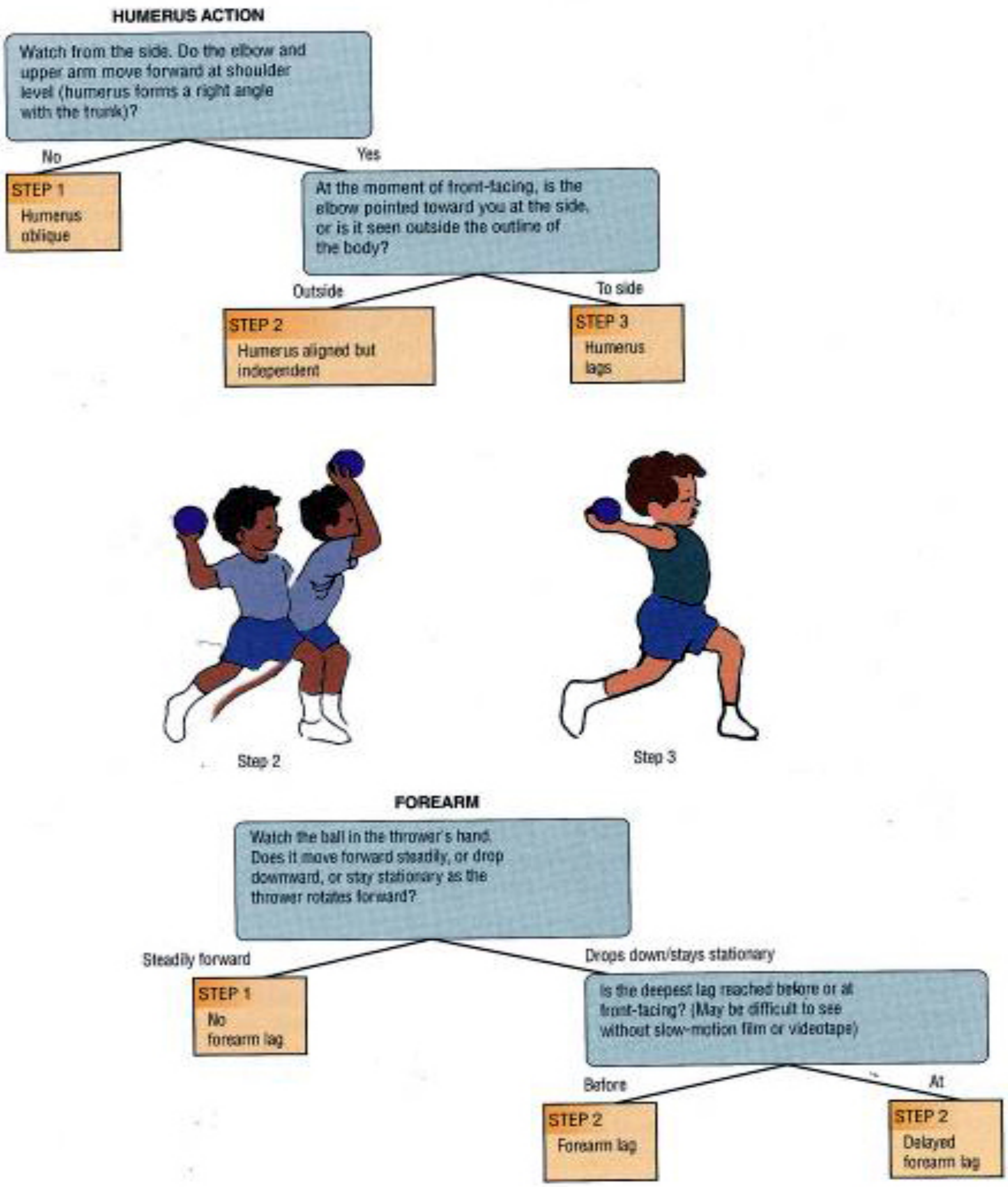

Throwing for Speed


Throwing for Accuracy

Appendix E

Observation plan for throwing





Note. From *Life Span Motor Development.* By K.M. Haywood and N. Getchell, 2014.

Appendix F

Data analysis procedures for each research question.

Research Question 1: Does children throwing competency change as a result of exposure to mastery climate? (as measured by the TGMD-3 assessment, Roberton and Halverson's developmental sequence for throwing, and throwing velocity).		
Dependent Variable (s)	Independent Variable (s)	Analyses
1. TGMD-3 throwing score 2. Roberton and Halverson's developmental sequence throwing score 3. Throwing velocity	Mastery motivational climate	Paired-samples *t* test.
Research Question #2: What is the extent to which guided throwing practice volume influences gains in TGMD throwing competency (as measured by the TGMD-3 assessment)?		
Dependent Variable (s)	Independent Variable (s)	Analyses
TGMD throwing post-test score	1.Pre-test TGMD throwing score 2. Guided throwing practice volume 3.Gender 4.Gender x guided throwing practice volume	Hierarchical, step-wise multiple linear regression. Each independent variable was added step by step to determine if it explained a significant amount of variance than the previous step.
Research Question #3: What is the extent to which guided throwing practice volume influences gains in Roberton and Halverson's developmental sequence throwing		

competency?		
Dependent Variable (s)	Independent Variable (s)	Analyses
Roberton and Halverson's developmental sequence post-test throwing score	1.Pre-test Roberton and Halverson's developmental sequence throwing score 2.Guided throwing practice volume 3.Gender 4.Gender x guided throwing practice volume	Hierarchical, step-wise multiple linear regression. Each independent variable was added step by step to determine if it explained a significant amount of variance than the previous step.

Research Question #4: What is the extent to which guided throwing practice volume influences gains in throwing velocity?		
Dependent Variable (s)	Independent Variable (s)	Analyses
Throwing post-test velocity	1.Throwing post-test velocity 2.Guided throwing practice volume 3.Gender 4.Gender x guided throwing practice volume	Hierarchical, step-wise multiple linear regression. Each independent variable was added step by step to determine if it explained a significant amount of variance than the previous step.

Research Question #5: To what extent do children's characteristics (e.g., gender and initial skill level) relate to children's practice behaviors?		
Dependent Variable (s)	Independent Variable (s)	Analyses
1. Gender 2. Skill-level (high vs. medium vs.	1.Practice visits 2.Practice time 3. Practice trials	1. Run a *K* means cluster analysis to identify high versus low-

low)		skilled children based on pre-test throwing competency. 2. Welch *t*-test and Welch ANOVA were run to determine if there were differences in children's practice behaviors based on gender and skill level