THE EFFECT OF AN OBJECT CONTROL MOTOR SKILL INTERVENTION ON
THE MOTOR DEVELOPMENT OF PRESCHOOL AND KINDERGARTEN
CHILDREN WHO ARE ATTENDING AN URBAN ELEMENTARY SCHOOL

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy in the School of Physical Activity
and Educational Services at The Ohio State University

By

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ABSTRACT

Fundamental motor skills such as object control (OC) skills serve as the building blocks to more advanced movement (Seefeldt & Haubenstricker, 1982). OC skills tend to be delayed in children living in poverty (Hamilton, Goodway, & Haubenstricker, 1999). Additionally, perceptions of skillfulness in activities can influence engagement in physical activities (Ames, 1990, 1992; Nicholls, 1984). The purpose of this study was to investigate the influence of an eight-week, 480-min. OC skill intervention on the development of preschool and kindergarten-aged children in motor skill Intervention (I, n = 36) and Comparison (C, n = 47) groups. All children were evaluated using the OC subscale of the Test of Gross Motor Development-2 (Ulrich, 2000) and the Pictorial Scale of Perceived Competence and Social Acceptance (Harter & Pike, 1984) prior to and following the intervention period. The I group received 16, 30-min sessions of OC instruction. At pre-intervention, both the I (M = 9.11%, SD = 11.75) and C (M = 13.12, SD = 14.86) groups demonstrated delays in OC skills. There were no differences in OC skills (F [1, 89] = .53, p = .47, \( \eta^2 = .01 \)) or PPC scores (F [1, 89] = 3.26, p = .07, \( \eta^2 = .04 \)) between groups at pre-intervention. There was, however, a main effect for gender regarding OC scores (F [1, 89] = 19.10, p < 0.00, \( \eta^2 = .18 \)) with boys scoring higher than girls. A post-intervention MANOVA with repeated measures on OC raw scores and PPC total scores yielded a statistically significant Group X Time interaction (F [1, 75] =
14.44, $p < .00, \eta^2 = .16$) for OC scores, and for PPC scores ($F[1, 75] = 37.36, p < .00, p<00, \eta^2 = .33$). No significant post-intervention effects for gender ($F[1, 75] = .17, p = .69, \eta^2 = .00$) were detected regarding OC scores. Following the intervention, the I group was at the 53rd (SD=29.95) percentile as compared to the C group (26%, SD=23.49). These findings suggest that OC skills can be improved in as little as eight-weeks of instruction and have implications for early childhood motor skill programs.
“It is a crime against mankind to deprive children of successful learning when it is possible for virtually all to learn to a high level.”
(Benjamin S. Bloom, 1987)

To my family and friends who believed in me.
To Chad and my girls who were here to love me.
And to the children who were always excited to see me.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>v</td>
</tr>
<tr>
<td>Vita</td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xiii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xv</td>
</tr>
<tr>
<td><strong>Chapters:</strong></td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Need for the Study</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Fundamental Motor Skills</td>
<td>3</td>
</tr>
<tr>
<td>1.2.1 Object Control Skills</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Motor Skill Intervention</td>
<td>6</td>
</tr>
<tr>
<td>1.4 Perceived Competence</td>
<td>7</td>
</tr>
<tr>
<td>1.5 Concerns Regarding Children who are Attending Urban Elementary</td>
<td>10</td>
</tr>
<tr>
<td>Schools</td>
<td></td>
</tr>
<tr>
<td>1.6 Purpose of the Study</td>
<td>12</td>
</tr>
<tr>
<td>1.7 Scope/Overview of Methods</td>
<td>12</td>
</tr>
<tr>
<td>1.7.1 Variables Measured</td>
<td>12</td>
</tr>
<tr>
<td>1.7.2 Individuals Involved in the Study</td>
<td>13</td>
</tr>
<tr>
<td>1.8 Research Questions and Hypotheses</td>
<td>14</td>
</tr>
<tr>
<td>1.8.1 Research Question 1</td>
<td>14</td>
</tr>
<tr>
<td>1.8.1.1 Hypothesis 1</td>
<td>14</td>
</tr>
<tr>
<td>1.8.2 Research Question 2</td>
<td>15</td>
</tr>
<tr>
<td>1.8.2.1 Hypothesis 2</td>
<td>15</td>
</tr>
<tr>
<td>1.8.3 Research Question 3</td>
<td>15</td>
</tr>
<tr>
<td>1.8.3.1 Hypothesis 3</td>
<td>15</td>
</tr>
<tr>
<td>1.8.4 Research Question 4</td>
<td>15</td>
</tr>
<tr>
<td>1.8.4.1 Hypothesis 4</td>
<td>15</td>
</tr>
<tr>
<td>1.8.5 Research Question 5</td>
<td>16</td>
</tr>
<tr>
<td>1.8.5.1 Hypothesis 5</td>
<td>16</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3.4.4 Body Mass Index</td>
<td>72</td>
</tr>
<tr>
<td>3.4.5 Risk Factor Data</td>
<td>72</td>
</tr>
<tr>
<td>3.4.6 Field Notes</td>
<td>73</td>
</tr>
<tr>
<td>3.5 Procedures</td>
<td>73</td>
</tr>
<tr>
<td>3.5.1 Informed Consent</td>
<td>74</td>
</tr>
<tr>
<td>3.6 Object Control Motor Skill Intervention</td>
<td>74</td>
</tr>
<tr>
<td>3.6.1 Intervention Development</td>
<td>77</td>
</tr>
<tr>
<td>3.6.2 Training of Instructional Assistants</td>
<td>79</td>
</tr>
<tr>
<td>3.6.3 Lesson Implementation</td>
<td>80</td>
</tr>
<tr>
<td>3.6.4 Intervention Integrity</td>
<td>81</td>
</tr>
<tr>
<td>3.7 Comparison Condition</td>
<td>84</td>
</tr>
<tr>
<td>3.8 Rationale for Selection of Statistical Procedures</td>
<td>84</td>
</tr>
<tr>
<td>3.9 Data Analysis</td>
<td>87</td>
</tr>
<tr>
<td>3.9.1 Research Question 1</td>
<td>87</td>
</tr>
<tr>
<td>3.9.1.1 Hypothesis 1</td>
<td>87</td>
</tr>
<tr>
<td>3.9.2 Research Question 2</td>
<td>87</td>
</tr>
<tr>
<td>3.9.2.1 Hypothesis 2</td>
<td>87</td>
</tr>
<tr>
<td>3.9.2.2 Statistical Procedures for Hypothesis 1 and 2</td>
<td>88</td>
</tr>
<tr>
<td>3.9.3 Research Question 3</td>
<td>89</td>
</tr>
<tr>
<td>3.9.3.1 Hypothesis 3</td>
<td>89</td>
</tr>
<tr>
<td>3.9.3.2 Statistical Procedures for Hypothesis 3</td>
<td>89</td>
</tr>
<tr>
<td>3.9.4 Research Question 4</td>
<td>89</td>
</tr>
<tr>
<td>3.9.4.1 Hypothesis 4</td>
<td>90</td>
</tr>
<tr>
<td>3.9.5 Research Question 5</td>
<td>90</td>
</tr>
<tr>
<td>3.9.5.1 Hypothesis 5</td>
<td>90</td>
</tr>
<tr>
<td>3.9.5.2 Statistical Procedures for Hypothesis 4 and 5</td>
<td>90</td>
</tr>
<tr>
<td>3.9.6 Research Question 6</td>
<td>91</td>
</tr>
<tr>
<td>3.9.6.1 Hypothesis 6</td>
<td>91</td>
</tr>
<tr>
<td>3.9.6.2 Statistical Procedures for Hypothesis 6</td>
<td>92</td>
</tr>
<tr>
<td>4. Results</td>
<td>95</td>
</tr>
<tr>
<td>4.1 Research Question 1</td>
<td>95</td>
</tr>
<tr>
<td>4.1.1 Hypothesis 1</td>
<td>95</td>
</tr>
<tr>
<td>4.2 Research Question 2</td>
<td>96</td>
</tr>
<tr>
<td>4.2.1 Hypothesis 2</td>
<td>96</td>
</tr>
<tr>
<td>4.2.2 Results for Research Questions 1 and 2</td>
<td>96</td>
</tr>
<tr>
<td>4.3 Research Question 3</td>
<td>101</td>
</tr>
<tr>
<td>4.3.1 Hypothesis 3</td>
<td>101</td>
</tr>
<tr>
<td>4.3.2 Results for Research Question 3</td>
<td>101</td>
</tr>
<tr>
<td>4.4 Research Question 4</td>
<td>104</td>
</tr>
<tr>
<td>4.4.1 Hypothesis 4</td>
<td>104</td>
</tr>
<tr>
<td>4.5 Research Question 5</td>
<td>104</td>
</tr>
<tr>
<td>4.5.1 Hypothesis 5</td>
<td>104</td>
</tr>
<tr>
<td>4.5.2 Results for Research Questions 4 and 5</td>
<td>105</td>
</tr>
<tr>
<td>4.6 Research Question 6</td>
<td>108</td>
</tr>
<tr>
<td>4.6.1 Hypothesis 6</td>
<td>108</td>
</tr>
</tbody>
</table>
5. Discussion/Implications/Recommendations ................................................. 113
  5.1 Discussion for Hypothesis 1................................................................. 114
    5.1.1 Implications for Hypothesis 1 ....................................................... 118
    5.1.2 Future Research for Hypothesis 1 ..................................................... 118
  5.2 Discussion for Hypothesis 2................................................................. 119
    5.2.1 Implications for Hypothesis 2 ....................................................... 121
    5.2.2 Future Research for Hypothesis 2 ..................................................... 122
  5.3 Discussion for Hypothesis 3................................................................. 122
    5.3.1 Implications for Hypothesis 3 ....................................................... 125
    5.3.2 Future Research for Hypothesis 3 ..................................................... 126
  5.4 Discussion for Hypothesis 4................................................................. 126
    5.4.1 Implications for Hypothesis 4 ....................................................... 129
    5.4.2 Future Research for Hypothesis 4 ..................................................... 130
  5.5 Discussion for Hypothesis 5................................................................. 130
    5.5.1 Implications for Hypothesis 5 ....................................................... 134
    5.5.2 Future Research for Hypothesis 5 ..................................................... 134
  5.6 Discussion for Hypothesis 6................................................................. 135
    5.6.1 Implications for Hypothesis 6 ....................................................... 138
    5.6.2 Future Research for Hypothesis 6 ..................................................... 139
  5.7 Summary................................................................................................. 139
    5.7.1 Summary of Findings ....................................................................... 140
    5.7.2 Summary of Implications ................................................................... 141
    5.7.3 Summary of Recommendations for Future Research ....................... 143

References........................................................................................................ 145

Appendices
  A. Test of Gross Motor Development-2 Object Control Subscale ................. 156
  B. Pictorial Scale of Perceived Competence and Social Acceptance
     Perceived Physical Competence Subscale .............................................. 161
  C. Risk Factors Worksheet ........................................................................ 170
  D. Sample Parental Consent Letter .............................................................. 172
  E. Human Subjects Institutional Review Board Letter .................................. 175
  F. Columbus Public School Board Letter ..................................................... 177
  G. Principal of Intervention School Approval Letter .................................... 180
  H. Principal of Comparison School Approval Letter ..................................... 182
  I. Instructional Skill Analysis and Cue Sheet ................................................. 184
  J. Sample Lesson Plan ................................................................................ 187
  K. Intervention Integrity Worksheet ............................................................. 190
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Specific Demographic Information of Participants</td>
<td>64</td>
</tr>
<tr>
<td>3.2 Summary of Instrumentation</td>
<td>66</td>
</tr>
<tr>
<td>3.3 Allotment of Instructional Time for Object Control Skills</td>
<td>76</td>
</tr>
<tr>
<td>3.4 Intervention Integrity Accuracy Data</td>
<td>83</td>
</tr>
<tr>
<td>3.5 Data Analysis Chart</td>
<td>93</td>
</tr>
<tr>
<td>4.1 Pre-intervention to Post-intervention Scores by Group</td>
<td>97</td>
</tr>
<tr>
<td>4.2 Pre-intervention to Post-intervention OC Skill Scores by Group and Gender</td>
<td>98</td>
</tr>
<tr>
<td>4.3 Pre-intervention, Post-intervention Scores by Group and Gender...</td>
<td>100</td>
</tr>
<tr>
<td>4.4 MANOVA and Post-Hoc t-Tests Regarding Pre-intervention OC and PPC Scores</td>
<td>101</td>
</tr>
<tr>
<td>4.5 Means, Standard Deviations, and Correlations for Predictor and Criterion Variables at Pre-intervention</td>
<td>103</td>
</tr>
<tr>
<td>4.6 Predictors of Pre-intervention OC Scores</td>
<td>103</td>
</tr>
<tr>
<td>4.7 MANOVA Regarding Pre-intervention to Post-intervention OC and PPC Improvement</td>
<td>106</td>
</tr>
<tr>
<td>4.8 ANOVA Regarding Post-intervention OC Scores</td>
<td>107</td>
</tr>
<tr>
<td>4.9 Post-Intervention Means, Standard Deviations, and Correlations for Predictor and Criterion Variables for Intervention Group</td>
<td>110</td>
</tr>
<tr>
<td>4.10 Predictors of Post-intervention OC Scores for the Intervention Group</td>
<td>110</td>
</tr>
</tbody>
</table>
4.11 Post-Intervention Means, Standard Deviations, and Correlations for Predictor and Criterion Variables for Comparison Group. 112

4.12 Predictors of Post-intervention OC Scores for the Comparison Group. 112
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Data Matrix Plot</td>
<td>86</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

Children’s play and activity patterns are commonly associated with well-being, mastery over environment, and overall development (Berk, 2000). Activity leads a child to explore his/her environment and meet cognitive, social, and physical needs (Berk, 2000; Pellegrini & Smith, 1998). As a child’s brain matures, the type and amount of play a child prefers changes to meet her/his needs (Piaget, 1962). Many theories of development, including the dynamical systems theory (Thelen & Ulrich, 1991) suggest that a child must be active and stimulated in order to develop to his/her potential. One of the most common forms of stimulation for a child comes from movement activities (Pellegrini & Smith, 1998).

A child’s risk factors, poverty status, and gender may substantially affect her/his motivation, persistence, skill level, and success at play activities (Ames, 1992, 1995; Garcia, 1994; Goodway & Branta, in press; Goodway & Rudisill, 1996; Sweeting & Rink, 1999). Children who grow up in poverty situations typically come from environments that may negatively impact opportunity for success in physical activities (Gabbard, 2000; Goodway & Branta, in press). Low socio-economic communities typically have fewer resources for recreation and movement experiences than more affluent communities (Goodway & Branta, in press). Additionally, the neighborhoods and playgrounds in poor communities are often ill equipped and unsafe for play and activity (Goodway & Branta, in press). Research has suggested that by the time they enter
school, children who are growing up in poverty already demonstrate developmental delays in motor skills (Goodway & Rudisill, 1996; Hamilton, Goodway, & Haubenstricker, 1999), which would include object control activities. For these reasons, as well as a nationally renewed focus on public health and physical activity (United States Department of Health and Human Services [USDHHS], 1996; 2000), this study was undertaken in an effort to positively enhance object control motor skill development in young children who are growing up in poverty.

Need for the Study

Although a number of studies have examined physical and motor development of elementary school-aged children (Faucette, Sallis, McKenzie, Alcaraz, Kolody, & Nuger, 1995; Gilliam, Freedson, Geenen, & Shaharay, 1981; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999; Sweeting & Rink, 1999; Taylor, Yancey, Leslie, Murray, Cummings, Sharkey, Wert, James, Miles, & McCarthy, 1999; Theeboom, De Knop, & Weiss, 1995; Trost, Pate, Ward, Saunders, & Riner, 1999), few have examined the development of preschool and kindergarten-aged children (Conner-Kuntz & Dummer, 1996; Poest Williams, Witt, & Atwood, 1989; Sallis, Nader, Broyles, Berry, Elder, McKenzie et al., 1993). Fewer still have focused specifically upon object control motor skill development and examination of gender differences.

Specifically, this study utilized the dynamical systems framework (Kamm, Thelen, & Jensen, 1990; Newell, 1984; Thelen & Ulrich, 1991; Ulrich & Ulrich, 1993) to investigate the complex interactions among variables of the learner, the task, and the
environment and to explore ways in which teachers might manipulate task and environmental conditions to create appropriate learning situations for children who live in poor, urban settings.

The need for this study was based upon: (a) a concern regarding the object control motor skill development of young girls and boys who are in poverty; (b) the potential relationship between early motor skill development and later involvement in physical activity; and (c) the implications of early motor skill instruction to meet the developmental needs of young girls and boys who are growing up in poverty.

**Fundamental Motor Skills**

Motor development encompasses changes in motor behavior throughout the lifespan, as well as the processes responsible for those changes (Clark, 1994; Ulrich, 2000). The development of fundamental motor skills (FMS) forms the basis for later movement and physical skill (Clark, 1994; Gabbard, 2000; Haywood & Getchell, 2002; Payne & Isaacs, 2002; Seefeldt, 1982). Fundamental motor skills serve as the building blocks for movement, game, and sport skills (Gallahue, 1981, Gabbard, 2000; Haywood & Getchell, 2002; Payne & Isaacs, 2002; Seefeldt, 1982). Fundamental motor skill achievement is critical to the overall development of children (Gallahue, 1981; Kogan, 1982; Seefeldt, 1980), and motor skills emerge and evolve during the preschool and early elementary school years (Ulrich, 2000). It is believed that during the early elementary school years, children must develop FMS to a certain “proficiency level” in order to be able to perform more complex movement skills and patterns (Seefeldt, 1982). These movement experiences in the early years play a substantial role in the development and maturation of fundamental motor skills (National Association for Sport and Physical
Education [NASPE], 2002; Ulrich & Ulrich, 1993). Because early movement experiences are so important to the overall development of children, national guidelines have been developed regarding activity for children birth through age 5 (NASPE, 2002).

Object Control Skills

Fundamental motor skills include object control and locomotor skills. These skills help children control their bodies, manipulate their environment, and form complex skills and movement patterns involved in sports, dance, gymnastics, and other activities (Seefeldt, 1980). Object control activities include skills such as throwing, catching, kicking, dribbling, striking, and rolling (Ulrich, 2000). The development of proficiency in object control skills is particularly important, as these skills form the foundation of many sports and games (Seefeldt, 1980, 1982). To illustrate, the skill of catching is necessary in activities such as baseball, basketball, football, and soccer. The development of factors such as finger dexterity, eye-hand (or eye-foot) coordination, timing, and balance will influence a child's success at object control skills, and thus participation in physical activities (Seefeldt, 1980, 1982). A child who demonstrates efficient and skillful movements, therefore, will be more likely to experience success and enjoyment from physical activities and will also be more likely to pursue activities throughout her/his lifetime (Gallahue, 1987; Haywood & Getchell, 2002).

Mastery of FMS such as object control skills is required in order to succeed in physical activity (Seefeldt, 1982) and in overall development (Gallahue, 1987). If these skills are neglected, children may experience failure and frustration in sport and game
activities. Such negative consequences may contribute to poor perceptions of activity and in the long term, to an inactive lifestyle (National Association for Sport and Physical Education [NASPE], 2002; Payne & Isaacs, 2002).

Fundamental motor skills do not naturally emerge as mature patterns of movement, rather, they must be taught and practiced (Gabbard, 2000; Haywood & Getchell, 2002; Newell, 1984). Although many children pass through a developmental and predictable series of motor patterns, the rate at which they enter and remain in each pattern tends to be unique to the learner (Roberton & Haiverson, 1984). Current motor development theory called dynamical systems (Thelen & Ulrich, 1991), views motor skill development as context and learner specific. Interactions among many factors (subsystems) within the learner, the task, and the environment will influence motor skill development (Newell, 1984; Newell & Corcos, 1993; Thelen & Ulrich, 1991). As a result, certain populations of children may not demonstrate the necessary learner and environmental characteristics to support the typical development of FMS. One such population may include urban children living in poverty.

A number of studies (Connor-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Hamilton et al., 1999) have found that children, who are disadvantaged and/or live in poverty, demonstrate delays in motor skill performance. Further, these studies suggest that the delays may be an indication of the lack of environmental support for these children to develop fundamental motor skills (Goodway & Rudisill, 1997; Hamilton et al., 1999). Given these data, it is important to examine the role of early motor skill interventions in remediating developmental delays in young children who are growing up in poor, urban settings.
Motor Skill Intervention

Research has suggested that by the time they enter school, children who are growing up in poor, urban environments already demonstrate developmental delays in motor skills (Goodway & Rudisill, 1996; Hamilton et al., 1999), which would include object control skills. Therefore, motor skill intervention is important through the use of quality physical education programming (Graham, Holt/Hale & Parker, 1998). These programs should include both developmentally and instructionally appropriate practice (Council on Physical Education for Children [COPEC], 1992, p.3).

Developmentally appropriate practice recognizes the varied and individual capacities of children, and accommodates these characteristics within the instructional environment (COPEC, 1992). Instructionally appropriate practice considers what is currently known regarding best instructional practice through documented research (COPEC, 1992). Developmentally and instructionally appropriate teaching currently emphasizes such principles as providing sufficient and suitable practice toward the learning goal, a variety of tasks for learner success, clearly communicating tasks and outcomes to learners, selection of critical elements and corresponding cues of performance, and encouragement of students to develop at their own rate (Rink, 1994; Rink, French, Werner, Lynn, & Mays, 1991; Sweeting & Rink, 1999). Additionally, content development, incorporating task and skill analysis for identification of patterns of movement and arrangement of instructional tasks with clear progressions of scope and sequence, contribute to effective instruction (Rink et al., 1991). Teachers who are aware of and utilize such procedures in motor skill instruction are likely to positively affect student learning and acquisition (Rink, 1994; Rink et al., 1991; Sweeting & Rink, 1999).
Early motor skill instruction seems to bring about positive changes in the motor skill development of children (Conner-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Halverson, 1966; Hamilton et al., 1999; Kelly, Dagger, & Walkley, 1989; Miller, 1978; Valentini, 1997). Motor skill interventions with structured approaches that have been directed by motor development professionals (Conner-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997) have yielded significant gains in the FMS development of children from pre-intervention to post-intervention. Additionally, motor interventions utilizing less direct approaches (Kelly et al., 1989; Miller, 1978) and parents as instructors (Hamilton et al., 1999; Valentini, 1997) also demonstrated significant gains in FMS. Overall, the literature suggests that as little as eight weeks of motor skill instruction can result in positive and significant changes in the FMS development of children (Hamilton et al., 1999).

The preschool and kindergarten years are considered prime times to develop children’s FMS (Seefeldt, 1980, 1982). Many early childhood programs, however, focus upon cognitive, social, and fine motor instruction while limiting physical activities (Poest et al., 1989). Without motor skill intervention, children who are living in poverty may increasingly find themselves with motor skill deficiencies and physical activity disadvantages as compared with their peers.

**Perceived Competence**

Children’s perceptions of their skill level in activities can be a powerful influence on their engagement in those activities (Ames, 1981, 1990, 1992; Ames & Ames, 1981; Nicholls, 1984). Thus, it is important not only to consider how children perform motor skills, but also how they perceive their motor-skill abilities. Differing perceptions of
motor-skill competence result in variations in motivational quality, emotional reactions, and performance, which affects the outcome of the behavior or performance (Ames, 1981, 1990, 1992; Ames & Ames, 1981; Weiss & Ebbeck, 1996). Children are thought to pursue relatively similar types of goals in differing subject-area classes in school (Ames, 1981; Ames & Ames, 1981; Duda & Nicholls, 1992), however, their perceptions of their abilities within a specific situation or class can influence the types of goals that students choose within that situation (Ames, 1981, 1992, 1995; Ames & Ames, 1981). Social comparative information such as knowledge of how one performs relative to others, and the contingent reward distribution such as praise or grades can influence not only how children evaluate their own abilities (Ames, 1995; Ames & Ames, 1981; Nicholls, 1984), but also the perceived causes of their success and failures (Ames, 1981, 1990; Ames & Ames, 1981; Duda & Nicholls, 1992; Nicholls, 1984). In general, students who are motivated to master, or complete tasks tend to have an adaptive pattern of learning outcomes. On the other hand, students who are primarily motivated to win, or be better than someone else tend to have maladaptive patterns which can be especially detrimental for low-achieving students (Ames, 1992, 1995; Ames & Ames, 1981; Nicholls, 1984; Theeboom et al., 1995).

Perceived competence can be thought of as the motivation to participate or continue in an activity based upon how an individual perceives his/her capability in that activity (Harter, 1978). Perceived competence in activity may influence persistence, motivation, effort, expectations, and ultimately, performance (Good, 1987; Martinek & Griffith, 1984; Weiner, 1985). The development of perceived competence is dependent upon four psychological constructs including past experiences, difficulty of challenge
associated with the task or performance, reinforcement and personal interactions with significant others regarding the task or the performance, and intrinsic motivation (Harter, 1978). When an attempt at a task is, or is perceived as successful, a child will be likely to attempt to repeat the prior performance. On the other hand, when an attempt is not successful, a child may attempt to change or modify the perceived causes to produce a more positive outcome in order to master the task.

When activities are structured in a way children perceive as stressful, they are likely to avoid participation, and therefore increase their skill deficit (Ames, 1981, 1990, 1992; Ames & Ames, 1981; Bandura, 1977, 1986). Structuring the environment for success or task mastery not only helps children manage their stress level, but also to change their locus of control from external or uncontrollable, to internal (Bandura, 1977, 1986), thus reducing activity avoidance and increasing perceived competence in many situations. In addition, Harter (1978) stresses that attempts at performance that result in success, positive reinforcement, and a sense of internal control are likely to be continued. Further, such attempts are likely to be characterized by persistence and effort rather than by ability. Children who perceive themselves as competent due to successful experiences will be more motivated to remain involved and continue to persist at tasks than students who do not perceive themselves to be competent.

Perceived competence may be especially important when considering children who are poor. These children tend to have fewer opportunities to practice and master tasks, and therefore, are more likely to experience failure more frequently than their peers (Ames, 1990, 1992; Berk, 2000; Goodway & Rudisill, 1996). Additionally, gender differences have been found in perceived competence (Brustad, 1993; 1996; Goodway &
Rudisill, 1996). Research has indicated that even by the first grade, girls assess their athletic ability more negatively than boys in spite of their objective equality in skill (Brustad, 1993). Because perceived competence may evolve as task behavior improves (Harter, 1982), it is important to examine perceived physical competence as it relates to motor skill intervention experiences provided to preschool and kindergarten children who are living in poor, urban settings.

Concerns Regarding Children who are Attending Urban Elementary Schools

There has been national concern regarding the growth and development of children who are living in poverty by current programs and initiatives (Annie E. Casey Foundation [AECF], 2001; USDHHS, 1996; 2000). National data reveal that 16% of children growing up in Ohio grow up in poverty (AECF, 2001). The rate of Ohio children who are living in extreme poverty, (income below 50% of poverty level), is the same as the national average of 8%, and Columbus is ranked 19th of 50 large cities nationally on this measure (AECF, 2001). The percent of Columbus children under age 15 living in distressed neighborhoods in 1990 was also ranked 19th of 50 large cities, at 15% (AECF, 2001). From these statistics, it can be concluded that many children growing up in Ohio are exposed to environments that may be detrimental to their development, including their motor skill development. Preschool programs for children raised in such environments have emerged over the last two decades. Often, their poverty status and the presence of risk factors in their lives identify children served by early-intervention preschool programs (Goodway-Shiebler, 1994).

Risk factors in a child’s life can be processes, events, or characteristics that increase the probability that developmental delays/concerns will occur (Kazdin, 1995). Risk
factors tend to be additive in nature; that is, the presence of one risk factor increases the probability that other risk factors will accumulate. Risk factors can be categorized as child factors, family factors, school factors, and other factors (Kazdin, 1995).

One of the major risk factors for children is poverty, which tends to be associated with other risk factors such as poor supervision, poor nutrition, and reduced access to public programs and services (Kozol, 1991; Sallis et al., 1993). Poverty also tends to be associated with physical inactivity. National data indicates that physical activity rates decrease as income level decreases, and that children from poor, urban families face many challenges to leading a physically active lifestyle while striving to overcome the burden of poverty (USDHHS, 1996; 2001). In fact, poor and minority populations have been targeted by the Centers for Disease Control and Prevention because they appear to be under-served by current physical education programs, and demonstrate significant needs both as children and as adults (USDHHS, 1996; 2001).

As educators strive to meet the needs of students who are living in poverty, information regarding the motor skill development of young children who are poor may provide insight regarding curricular concerns. Additionally, educators need effective motor skill programs to remediate the developmental delays often found in these populations. For these reasons, as well as a nationally renewed focus on public health and physical activity, this study was undertaken in an effort to positively enhance the object control skill development of young children who are living in poor, urban environments.
Purpose of the Study

The purpose of this study was to investigate the influence of an eight-week instructional program on the object control development of preschool and kindergarten-aged girls and boys who were living in poor, urban settings. The research objectives for the study were to determine: (a) the pre-intervention measures of object control skills and perceived physical competence of the participants; (b) if gender differences in measures of pre-intervention object control skills and perceived physical competence were present; (c) predictors of object control motor skill performance prior to an eight-week object control motor skill intervention; (d) the impact of an eight-week object control motor skill intervention on object control skills and perceived physical competence of the participants; (e) if gender differences in object control skills and perceived physical competence were present following an eight-week object control motor skill intervention; and (f) predictors of object control motor skill performance following an eight-week object control motor skill intervention. The objectives of this study were important to examine in order to inform programming needs for preschool and kindergarten aged girls and boys who were attending urban elementary schools.

Scope/Overview of Methods

Data were collected regarding object control motor skill performance, perceived physical competence, fitness, and risk factors.

Variables Measured

Data were collected in the following areas: object control motor skill performance, perceived physical competence, body mass index, grip strength, and risk factor indication. The first two instruments were administered prior to (pre-intervention)
and following (post-intervention) an eight-week object control motor skill intervention, with the remaining instruments being administered only once during the investigation.

Ulrich’s (2000) Test of Gross Motor Development-2 (TGMD-2) provides quantitative information regarding actual motor behavior, or physical competence of children aged 3-10 years of age. The TGMD-2 has two subtests measuring object-control skills and locomotor skills. For the purposes of this study, only object control skills were assessed. The Harter and Pike (1984) Pictorial Scale of Perceived Competence and Social Acceptance (PSPCSA) for preschool and kindergarten children was used to assess perceived physical competence. Perceived physical competence measures were utilized as indicators of students’ perceptions of her/his own physical abilities. Grip strength was used as a measure of overall body strength. Maximal grip strength was measured using a standard handgrip dynamometer assessment instrument. Body composition measures were administered using a body mass index (BMI) for height and weight. The BMI score was used as an indicator of healthy ranges of height/weight measures.

Classroom teachers completed child risk-factor information during week 6 of the intervention period and following the completion of a required visit to the home of each child in her classroom.

*Individuals Involved in the Study*

This study was conducted in a large multi-ethnic city in an urban school district in the Midwestern United States. Two schools, one termed “intervention” and one termed “comparison”, served as the unit of analysis for this study. Each school serves a diverse student body consisting of approximately 200 students from preschool to 5th grade. Within schools, two classrooms of participants, one preschool and one kindergarten,
formed the intervention and the comparison groups. The intervention group contained 47 children (29 girls and 18 boys), and the comparison group contained 51 children (23 girls and 28 boys). A female investigator with a motor development background served as the lead teacher for the object control motor skill intervention, which was provided to the intervention groups. One female Caucasian and one female African graduate student assisted the investigator during data collection. Additionally, 19 undergraduate motor development students fulfilling a 10-hour service learning requirement, supervised by the primary investigator, aided in facilitation of object control activities at learning stations during the intervention.

Research Questions and Hypotheses

The following research questions and corresponding hypotheses were designed to guide data analysis (Research questions, hypotheses, and statistical procedures can be seen in Table 3.5):

Research Question 1

What are the pre-intervention object control skills and perceived physical competence of participants?

Hypothesis 1

a) All groups of participants will evidence delay (below the 25th percentile) in object control (OC) skills at pre-intervention.

b) There will not be significant differences between intervention and comparison groups on measures of OC skills at pre-intervention.

c) There will not be differences between groups on measures of perceived physical competence (PPC) at pre-intervention.
Research Question 2

Are there gender differences in pre-intervention OC skills and/or PPC of participants?

Hypothesis 2

a) Prior to intervention, male participants will demonstrate higher levels of OC skills as compared to female participants.

b) Male participants will demonstrate higher levels of PPC than female participants, prior to intervention.

Research Question 3

What are the predictors of object control performance prior to the intervention period?

Hypothesis 3

It is hypothesized that gender, age, risk factors, pre-intervention PPC, body mass index (BMI), and grip strength will explain a moderate (.30-.49; Davis, 1971) percent of the variance in pre-intervention OC skill performance for participants.

Research Question 4

Do OC skills and/or PPC improve as a result of participation in an eight-week object control intervention?

Hypothesis 4

a) The intervention group will have statistically significant pre-intervention to post-intervention improvement in OC skills as related to the comparison group, who will not show significant improvement across the intervention period.
b) Neither the intervention nor the comparison group will exhibit significant pre-intervention to post-intervention improvement in PPC.

c) The intervention group will have significantly higher post-intervention OC skill levels as related to the comparison group.

*Research Question 5*

What is the influence of gender on OC skills and PPC as a result of an eight-week object control motor skill intervention?

*Hypothesis 5*

a) There will not be a significant gender effect for OC skills from pre-intervention to post-intervention for the intervention group.

b) There will not be a significant gender effect for PPC from pre-intervention to post-intervention for the intervention group.

c) Gender differences on post-intervention OC skills within the intervention group (female, male) are not expected at post-intervention.
Research Question 6

What are the predictors of object control performance for each group following intervention?

Hypothesis 6

a) It is hypothesized that for the intervention group, pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, BMI, grip strength, and pre-intervention PPC score will explain a substantial (.50-.69; Davis, 1971) percent of the variance in object control skills following the intervention period.

b) It is hypothesized that the variance in post-intervention OC skills for the comparison group will be moderately (.30-.49; Davis, 1971) predicted by the variables of pre-intervention OC skills, gender, age, risk factors, post-intervention PPC, pre-intervention PPC, body mass index (BMI), and grip strength.

Scope of the Study

Delimitations

This study is delimited to a group of young (preschool and kindergarten aged), primarily African-American and Caucasian children living in a large urban, mid-eastern U.S. city, who are living in poverty. Specific child risk factors for each participant also delimit the findings of this study. The classrooms of participants involved in this study included a teacher, a paraprofessional, and 18-33 children, which also delimits the generalizability of the findings of this investigation.
Limitations

The following were limitations to this investigation:

1. Classrooms of participants for this study were not randomly selected. Four intact classrooms were purposefully chosen from two schools.

2. The intervention was provided only to one school of participants. School characteristics, therefore, may have influenced the results.

3. Each classroom of participants had different teachers, paraprofessionals, and children. Characteristics of any of the above may have influenced the results of this investigation.

4. Factors such as the time of testing and participants' clothing or shoes worn during testing may have affected pre-intervention or post-intervention results.

5. The researcher planned and led all intervention sessions. Differences in station facilitators, however, may have influenced station participation or presentation of activities across the two intervention classes.

6. A few children in the kindergarten intervention group had prior experience with the researcher during the year preceding this study. Additionally, the teachers and paraprofessionals of the intervention groups had worked with the researcher during the 2000-2001 school year. This exposure may have influenced the results of this study.

Definition of Terms

Cue Words- Specific words used during the instruction of a motor skill which prompt the child to demonstrate the skill in a specific pattern, usually used to promote mature or efficient behavior (Graham et al., 1998).
*Criterion Elements of Form*- Evaluation of the motor performance of a skill based upon a specific level of mastery of the elements involved in the performance of that skill. Evaluation is based upon a behaviorally established standard for each element (Ulrich, 2000).

*Developmentally Appropriate*- Equipment, facilities, teaching techniques, etc. which are designed keeping individual characteristics in mind to allow the child to use correct technique while meeting the goal of the task (Payne & Isaacs, 2002). This practice recognizes the varied and individual capacities of children, and accommodates these characteristics within the instructional environment (COPEC, 1992).

*Fundamental Motor Skills*- (FMS) Basic, observable patterns of motor behavior that should be developed in childhood. FMS include locomotor and object control skills (Gallahue & Ozmun, 1998).

*Instructionally Appropriate*- Incorporates the best known practices, derived from both research and experiences teaching children, into a program that maximizes opportunities for learning and success for all children (Graham et al., 1998).

*Motor Development*- The area of study concerned with change and stability in motor behavior from conception until death (Haywood & Getchell, 2002)

*Object Control Skills*- (OC Skills) The FMS category requiring object manipulation and including the skills of catching, throwing, kicking, dribbling, striking, and rolling (Gallahue & Ozmun, 1998; Ulrich, 2000).
Perceived Physical Competence- (PPC) A dimension of self-evaluation emphasizing a child’s perception of his or her physical abilities (Harter, 1982).

Primary Caregiver- The primary caregiver is an adult with whom the child lives. This adult assumes the majority of the child-rearing duties for the child.

Triple A School- AAA schools are schools that have been identified based upon a large number of students scoring below criterion on standardized national tests. These schools are in danger of losing public funding and are critically in need of educational reform and Accelerated Academic Achievement (AAA) (Ohio State Board of Education).


Subsystem- Components of a system that are constantly interacting or changing, which combine to affect the system.

System Self-Organization- Self-organization occurs when subsystems cooperate to produce behavior within a specific context. Within the DST, there are no priority or dominant systems; only cooperating subsystems, each with its own contributions to the system.

Behavioral Attractors- Behavioral attractors are context specific and are the preferred performance behaviors of an individual given a certain context.

Constraint- Components of the system, which interact to form internal or external limiting conditions for the system. Constraints shape, and can enhance or retard behavior or movement.
Control Parameters- Control parameters are physical variables within systems or subsystems. As these variables change within the system, the behavior of the system also changes. Changes of the system may be externally invisible until the system reaches a critical point and a phase shift occurs. Control parameters do not control the system; rather, the system is sensitive to change of the control parameters.

Degrees of Freedom- Degrees of freedom are the number of variables within a system that are free to vary. Degrees of freedom in human movement combine to produce behavior. As an individual is exposed to the task within the environment, degrees of freedom within each of these subsystems interact, resulting in collective degrees of freedom which are less than the sum of the degrees of freedom of each of the subsystems. As an individual is exposed to certain conditions and/or tasks, the degrees of freedom within the subsystems no longer act individually and randomly. The degrees of freedom are reduced as subsystems cooperate.

Development- Development encompasses an individual’s dynamic transition through attractor states. Behavior emerges as the system attempts to coordinate its subsystems in order to produce the most comfortable and stable behavior, given the task and the context.
Phase Shifts- Dynamical systems are able to move from one pattern to another as a result of gradual or sudden changes in the variables or subsystems applied to a system. While variables within a system are changing, the system becomes very unstable as it seeks a more comfortable and stable configuration. A phase shift occurs as a system transitions from one qualitatively different attractor state to another.

Rate Limiter- As subsystems coordinate to reduce degrees of freedom in the production of behavior, certain variables work to reduce degrees of freedom at a slower rate than others do. The variable(s) that delay the intended behavior is/are called rate limiter(s). Until a rate limiter cooperates to produce the intended behavior, the system is unable to demonstrate that behavior. Often the rate limiter is also the control parameter.
CHAPTER 2

LITERATURE REVIEW

The dynamical systems theory will provide the framework of this study. This theory will lend insight regarding the dynamic and environmentally sensitive nature of motor skill development. The acquisition of fundamental motor skills, including object control skills, will be reviewed next, followed by motor skill intervention literature. Next, the link between motor skill development and perceived physical competence will be discussed. Finally, concerns and characteristics of the population of participants for whom this study was intended will be examined for programmatic implications.

Theoretical Framework

The dynamical systems theory (Kugler, Kelso, & Turvey, 1982; Magill, 1998; Newell, 1984; Thelen & Ulrich 1991) is a theoretical framework in which movement develops from a complex and multifaceted interaction among an individual, the task, and the environment (Newell, 1984). Unique variables within each of these subsystems may combine to produce effective or ineffective movements leading to task success or failure. The dynamical systems theory will be reviewed in this chapter in order to provide an understanding of the complex and dynamic nature of motor skill development.

Dynamical Systems Theory

Fundamental motor development does not occur automatically, rather, it is influenced by the interaction of cooperating subsystems (Gallahue, 1981; Ulrich & Ulrich, 1993). Subsystems may include factors such as the difficulty of the task, the
playground environment, and the skill level of the child. Many theories of development have emerged over the years, but few have considered the interaction of contextual and learner variables as the dynamical systems theory (DST). A DST perspective emphasizes the importance of all systems in contributing to a particular behavior or pattern of behaviors (Thelen & Ulrich, 1991) rather than reliance on a single subsystem. Each subsystem has its own path and rate of development, and subsystems are free to assemble, producing many possibilities of movement and many degrees of freedom (Thelen, 1985).

Many potential movement patterns (degrees of freedom) are possible in human movement. Each cooperating subsystem involved in specific movements, however, increases the possible degrees of freedom within that movement pattern. Due to the specific patterns involved in the development of specific motor behaviors such as those of object control skills, degrees of freedom within the task subsystem must be reduced, thus offering little variance of movement (Roberton, 1978). The resulting pattern of movement is referred to as a dynamical attractor state, and this attractor state will be stable to the degree that the cooperating subsystems continue to act together (Thelen & Ulrich 1991). The DST suggests that subsystems are driven to self-organize and reduce degrees of freedom in order to produce stability in movement. When the organism (person or learner) is driven to a new attractor state or pattern of movement, a control parameter initiates a perturbation, prompting the system to move from an old inefficient form of movement to a new, more stable and efficient form. This is what dynamical systems theorists refer to as a phase shift (Thelen & Ulrich 1991). For example, a child who is learning to throw may begin the movement with her feet stationary. As she
masters the overhand throwing motion, however, the momentum of her arm may cause her to lose balance during the throw and thus, she begins to initiate a step with the throw. As she continues to practice, she consistently steps while throwing. In this example, the old throwing motion becomes inefficient as the child attempts to throw harder. The momentum of the arm acts as the control parameter and leads the child to step, and therefore, to a new and more efficient attractor state of throwing. The child in this example has moved from a throw with no stepping motion (one attractor state), to a more forceful throw with a step (a more efficient attractor state).

Different individuals have different variables interacting within subsystems; however, children with similar backgrounds may also have similar interacting variables. Despite this, all individuals are unique, as no two children will have the exact same subsystems. Some of these variables might include genetics, coordination, experience, strength, and motivation. Each variable contributes its own degrees of freedom. An individual in a stable attractor state is able to demonstrate consistent stable movement with few degrees of freedom. The limited degrees of freedom within the movement pattern offer little variance of movement. An individual experiencing a phase shift or transition to a new attractor state, however, demonstrates many more degrees of freedom, which provide more variance in movement. This individual is much less likely to experience accuracy or stability of movement. Once potential interacting variables are identified, it is possible for teachers, through instruction or other environmental means, to perturb phase shifts by using teaching cues, modeling, different equipment, etc.
To illustrate, by asking the child in the previous example to throw harder, or to step on a plastic footprint on the floor, a teacher can modify the task in order to perturb or initiate a phase shift toward a new attractor state.

Regarding phase shifts, if one or more of the subsystems is unwilling or unable to cooperate in the phase shift, that subsystem is called a rate limiter. This rate limiter will prevent the system from assembling into a new pattern of movement (Thelen & Ulrich 1991). This notion is of particular interest due to the nature of atypical motor development. Variables within the environmental subsystem of children who are atypically developing may have a detrimental affect on the motor development of these children (Roberton, 1978). Children who are not able to lead physically active lifestyles, for example, have not been able to practice and therefore able to reduce the degrees of freedom required in the performance of many fundamental motor skills. Additionally, biological attributes such as strength or fitness can act as rate limiters for activities such as kicking or throwing.

From a DST perspective, transit toward efficient movement develops through patterns of less efficient stability, moving to more efficient instability, and finally efficient stability. In essence, it is the process of destabilization to stabilization of movement that depends upon the cooperation of the many subsystems of an organism. Motor skill development research has demonstrated that although there are many possibilities for movement behavior, individuals tend to exhibit common patterns (Roberton, 1978). These common patterns or attractor states allow teachers and researchers to design activities intended to perturb more efficient motor skill behavior.
Newell (1984) offered a useful paradigm to guide teachers and other professionals in the development of interventions for the purpose of enhancing the motor skill development of children. According to Newell (1984), constraints acting upon a child largely determine the developmental progressions of that child’s fundamental movement patterns. Constraints in the categories of organismic (learner), task, and environment essentially “self-organize” (Newell, 1984, p. 342) to produce motor responses thought to be most efficient given the context. Constraints under these three categories can serve to promote or limit motor development, with the notion of a constraint in DST being seen as a shaper of movement patterns. System self-organization is one of the driving concepts behind the DST, as the system automatically seeks stabilization within the context given the demands upon the learner, the task, and the environment. Organismic or learner constraints may include body weight, height, strength, balance, and body shape (Newell, 1984). As a child grows, these learner constraints change in relation to one-another, and to the total system. The focus of task constraints includes the goal of the activity, the rules imposed, and the equipment available (Newell, 1984). For example, many games such as basketball or soccer have a specific goal, which is to score points, but the way a child can go about achieving that goal may be ambiguous. On the other hand, an activity such as a specific dive in platform diving may specify that a specific pattern of coordinated movements be followed. Environmental constraints are those aspects of performance that are generally external to the performer such as light and shadows in the room, temperature, and gravity (Newell, 1984). Environmental constraints are not usually adaptations of the task, however, task and environmental constraints are not necessarily mutually exclusive (Newell, 1984). For example, designing a skill station for kicking
may include placing a white target with colored spots on the wall in the gym and graduated distances from which to kick. In this instance, the environmental and the task constraints are highly related. The task of kicking was modified to include kicking choices of colored spots from different distances, and environmental modifications in the form of a target with colored spots at different heights and starting points on the floor at different distances were implemented. In order to understand the complex interactions among characteristics of the learner, the task, and the environment in the development of object control skills, this review will provide insight regarding learner and environmental variables as well as possible task and environmental modifications.

*Application of DST to Motor Skill Interventions*

From a DST perspective, motor skills emerge from the combinations and interactions of many subsystems. New skills, therefore, may be a product of the interactions of cognitive instructions, perceptions, motivation, physical fitness, and practice, all within a particular context (Newell, 1984; Thelen, 1985). Within this complex system, one or more variables may be acting as a rate limiter. For example, if every variable within the subsystems acting upon the system is in place except for the practice variable, the behavior will not be evidenced until the system has received sufficient practice in the context. Additionally, other individual differences among children may work to facilitate or inhibit the desired performance.

As a researcher and teacher, it is often difficult to identify, describe, control, and understand the most influential variables and interactions affecting movement behavior. Using a DST approach, a teacher should consider the influence of learner constraints on motor performance and manipulate the task and the environmental factors in order to
promote motor skill development. System self-organization in the production of movement responses within the DST perspective results from cooperation of many subsystems. The DST emphasizes the importance of attention to context and individual differences. Investigation of children in their natural ecology is critical if we are to explain motor performance, and especially the motor performance of children who are growing up in poverty.

Fundamental Motor Skills

Motor development encompasses changes in motor behavior throughout the lifespan, as well as the processes responsible for those changes (Clark, 1994; Ulrich, 2000). The development of fundamental motor skills (FMS) forms the basis for later movement and physical skill (Clark, 1994; Gabbard, 2000; Haywood & Getchell, 2002; Payne & Isaacs, 2002; Seefeldt, 1982). Fundamental motor skills include object control, locomotor, and non-locomotor skills. These skills help children control their bodies, manipulate their environment, and form complex skills and movement patterns involved in sports, dance, gymnastics, and other activities (Seefledt, 1980, 1982). Object control activities include skills such as throwing, catching, kicking, dribbling, striking, and rolling (Ulrich, 2000).

Fundamental motor skills serve as the building blocks for movement, game, and sport skills (Gallahue, 1987, Gabbard, 2000; Haywood & Getchell, 2002; Payne & Isaacs, 2002; Seefeldt, 1982). Fundamental motor skill achievement is critical to the overall development of children (Gallahue, 1987; Kogan, 1982). Motor skill development emerges and evolves during the preschool and early elementary school years (Ulrich, 2000). During the early elementary school years, children must develop FMS to a certain
proficiency level in order to be able to perform more complex movement skills and patterns (Seefeldt, 1982). Movement experiences in the early years play a substantial role in the development and maturation of fundamental motor skills (Seefeldt, 1980; Ulrich & Ulrich, 1993). In fact, the National Association for Sport and Physical Education (NASPE) has established physical activity guidelines for children aged 0-5 years (2002). These guidelines, called Active Start, suggest that preschoolers should “develop competence in movement skills that are building blocks for more complex movement tasks” (NASPE, 2002, Guideline 3, p. 9).

Mastery of fundamental locomotor and object control movement patterns is essential for success in physical activity (Seefeldt, 1980, 1982) and in overall development (Gallahue, 1987). If these skills are neglected, children may experience failure and frustration in sport and game activities. Such negative consequences may contribute to poor perceptions of activity and in the long term, to an inactive lifestyle (Payne & Isaacs, 2002).

**Measurement of Fundamental Motor Skills**

Traditionally, motor development literature has referred to the emergence of specific patterns of movement in infancy and childhood as “stages” of development (Roberton, 1978). Stages of development assume predictable, invariant, and universal sequences of movement patterns. Progression in motor development is thought to be consistent, although the rate at which individuals develop movements through stages varies, dependent upon factors within the individual and the environment (Clark, 1994). Before a child is able to demonstrate a particular stage of movement for a motor skill, a
comfortable body position must be achieved. For example, in the object control skill of kicking, a child must be able to stand upright on one leg while swinging the other leg.

The motor development literature has identified two approaches to the development of FMS, the Total Body approach (Haubenstricker, Branta, & Seedfeldt, 1983), and the Component approach (Roberton & Halverson, 1984). The Total Body approach identifies stages of development for FMS that describe movements that the entire body unit is demonstrating as a single stage. In contrast, the Component approach suggests that there are stages of development for different body components. For instance, the Component approach for the overarm throw for force differentiates actions of the trunk, the backswing of the arm, the upper arm, the forearm, and the feet (Roberton & Halverson, 1984).

Another approach to measuring FMS allows teachers and researchers to identify criterion elements of form necessary for efficient and effective skill performance (Ulrich, 2000). Criterion elements of form identify the elements of how a child coordinates her trunk and limbs during the efficient performance of a skill rather than assessing the end result (Ulrich, 2000). For instance, criterion elements for the skill of catching include: a) a preparation phase where the hands are in front of the body and the elbows are flexed, b) the arms extend while reaching for the ball as it arrives, and c) the ball is caught with the hands only. Each of these elements is considered important to the efficient performance of catching and is identified and assessed for the presence or absence of the elements (Ulrich, 2000).
The Test of Gross Motor Development (TGMD, Ulrich, 1985) was designed to assess the criterion elements of form of the FMS of children aged 3-10 years. The TGMD has been widely used in the literature to document improvements of FMS as a result of intervention (Goodway-Shiebler, 1994; Hamilton et al., 1999; Valentini, 1997). Although the TGMD was useful as a screening tool for possible deficiencies in children’s motor skills, teachers and researchers recommended that gender differences be recognized in the scoring process, and that minority populations be included in the initial validation procedures for the test. Based upon these recommendations, the TGMD-2 was developed (Ulrich, 2000). The TGMD-2 recognizes and addresses differences in object control skill scores between genders, and includes new validity studies with special attention on demonstrating that the TGMD-2 is valid for a wide variety of subgroups as well as for the general population of children aged 3-10 years.

The TGMD-2 can be used as a programmatic guide or as a research tool (Ulrich, 2000). The test items were selected to represent the most common skills usually acquired by children in preschool and early elementary school (Ulrich, 2000). Specific strengths and skill deficiencies can be identified within each of the six locomotor and six object control skills measured by the TGMD-2 in order to help teachers design instructional programs that will be developmentally appropriate. Additionally, specific motor programs or interventions can be prescribed for children based upon individual results. As a research tool, the TGMD-2 can be used to investigate pre-intervention to post-intervention gains in motor skills following an intervention and can be utilized to study the motor development of various groups of children from differing cultures, regions, or schools (Dummer, Haubenstricker, & Stewart, 1996). Reliability for internal consistency
coefficients for the TGMD-2 OC subscale range from .85 to .92. In order to reduce ethnic, gender, and/or linguistic bias, the TGMD-2 was also tested on several subgroups of the normative population sample including females, males, European Americans, African Americans, Hispanic Americans, and Asian Americans. The OC subscale reliability coefficients for these groups range from .92 to .95, demonstrating that the TGMD-2 is similar in reliability for all of the subgroups tested (Ulrich, 2000).

Gender Differences in Fundamental Motor Skills

Improvements in FMS assessment techniques has illuminated gender differences in the acquisition and performance of FMS, particularly skills of object control (Payne & Isaacs, 2002). To illustrate, Thomas and French (1985) conducted a meta-analysis of 20 motor tasks and determined consistent differences between boys and girls. The authors further found the performance of boys exceeding that of girls to the greatest degree among skills of throwing (Thomas & French, 1985). Other researchers have also indicated gender differences in the development of object control skills such as throwing (Halverson, Roberton, & Langendorfer 1982; Haubenstricker et al., 1983), striking (Seefeldt & Haubenstricker, 1982), and kicking (Seefeldt & Haubenstricker, 1982), in favor of boys. It appears that gender differences in the acquisition and development of object control skills may be attributable to both biological and environmental sources (Payne & Isaacs, 2002).

In a wide-scale study regarding throwing, Haubenstricker et al. (1983) determined that 60% of boys exhibited the most mature pattern of throwing around the age of 5 years, while 60% of girls do not reach the same pattern until the age of 8.5 years. Additionally, Halverson et al. (1982) found that boys performed throwing tasks more
successfully at all ages. When considering catching, Haubenstricker et al. (1983) reported that 70% of 10-year-old boys were able to demonstrate the most mature form of catching whereas only 49% of 10-year-old girls were successful to the same degree.

Biological factors influencing object control skill performance during the grade school years may include limb length, hip/shoulder ratio, and muscle mass (Nelson, Thomas, & Nelson, 1991). Boys have been found to have longer limbs for propulsion, wider shoulders and more narrow hips for faster rotation, and more muscle mass for increased force as compared with girls (Nelson et al., 1991). Each of these factors may lead to enhance the performance of object control skills. Additionally, girls tend to evidence higher levels of body fat than do boys (Nelson et al., 1991). Similar evidence has not been investigated at the preschool level. Environmentally, Nelson et al. (1991) have determined that the presence of a male adult in the home may serve as a significant predictor of throwing performance. Similarly, East and Hensley (1985) found that the presence of a father figure to direct his daughter's play activities accounted for at least 25% of the variance in motor skill performance.

Additionally, gender data reveal that male participation rates surpass those of females, perhaps due to the lack of female mentoring and coaching offered to girls (Seefeldt & Ewing, 1997). Negative experiences in physical education class as well as body image concerns may also deter girls (aged 12-15 years) from participation in activity (Taylor et al., 1999). Activity programs providing social support and fun seem to be especially important for female participation (Taylor et al., 1999).
The Importance of Fundamental Motor Skills

Fundamental motor skills do not naturally emerge as mature patterns of movement, rather, they must be taught and practiced (Gabbard, 2000; Haywood & Getchell, 2002; Newell, 1984). Although many children pass through a developmental and predictable series of motor patterns, the rate at which they enter and remain in each pattern tends to be unique to the learner (Roberton & Halverson, 1984). Motor skill development, from a DST perspective, views motor skill development as context and learner specific (Thelen & Ulrich, 1991). Interactions among variables of many factors (subsystems) within the learner, the task, and the environment will influence motor skill development (Newell, 1984; Newell & Corcos, 1993; Thelen & Ulrich, 1991). Given the possible influence of biological and environmental risk factors, to which young children who are living in poverty may be exposed, it is possible that these children will demonstrate developmental delays in the performance of fundamental object control motor skills.

A number of studies (Connor-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Hamilton et al., 1999) have found that children who are at-risk, disadvantaged, and/or living in poverty demonstrated delays in motor skill performance. Further, studies suggest that these delays were an indication of the lack of environmental support for these children to develop fundamental motor skills (Goodway & Rudisill, 1997; Hamilton et al., 1999).

Specifically, in their work with children in Head Start (n = 35), preschool children who were typically developing (n = 11), and those who were developmentally delayed (n = 26), Connor-Kuntz and Dummer (1996) found that an eight-week intervention resulted

35
in significant improvements of fundamental motor skills for all of the participants. Despite these improvements in motor skill levels, the children who were Head Start and those with developmental delays still evidenced motor skills at levels below those predicted for their age, as measured by the Peabody Developmental Motor Scale.

Goodway and Rudisill (1997) examined the relationship between perceived physical competence using the Pictorial Scale of Perceived Competence and Social Acceptance (Harter & Pike, 1984) and actual competence measured by the TGMD (Ulrich, 1985). Participants consisted of African-American preschool children (n = 59) who were disadvantaged. The male participants in this study demonstrated object control skills at the 16th percentile, whereas the female participants demonstrated the same skills at the 5th percentile.

Hamilton et al. (1999) found that preschoolers who were at-risk for developmental delay or educational failure demonstrated delays in object control skills as measured by the TGMD (Ulrich, 1985) prior to an eight-week motor skill intervention. After designing and implementing a parent-assisted motor skill intervention, children who received the intervention demonstrated object control skills at the 67th percentile as compared to children who did not receive the intervention, who performed at the 15th percentile.

Given these data, it is important to examine the role of early motor skill interventions in remediating motor skill developmental delays in young children who are disadvantaged.
Motor Skill Intervention

Importance of Motor Skill Intervention

Children who are at-risk, disadvantaged, and/or are growing up in poverty demonstrate developmental delays in FMS (Connor-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Hamilton et al., 1999) and are thus in need of motor skill intervention. Additionally, Healthy People 2010 has indicated the importance of increasing physical activity programming for poor, urban populations such as low income and minority groups (USDHHS, 1996; 2001). Certain populations of children seem to have a disproportionately greater risk of being physically inactive (USDHHS, 1996; 2000). Gender, income level, and ethnicity may substantially influence a child’s movement opportunities. The prevalence of physical inactivity is higher among females than males, and among African American females than Caucasian females (USDHHS, 1996). National data indicates that physical activity rates decrease as income level decreases (USDHHS, 1996; 2001). As a result, poor populations have been identified as a prioritized population to receive special programs on physical activity because they appear to be under-served by current physical education programs, and demonstrate significant activity needs both as children and as adults (USDHHS, 1996; 2001).

Of the many potential risk factors in a child’s life, poverty seems to be an overriding factor influencing young minority children growing up in urban environments (AECF, 2001). Minority children are more likely than Caucasian children to grow up in poverty (AECF, 2001). Children living in poverty typically belong to communities that are less likely to have school activity programs and recreational opportunities than more affluent communities (Branta & Goodway, 1996). Additionally, the streets and the
playgrounds of these communities are often unsafe places in which to exercise or play (Branta & Goodway, 1996). The influence of poverty in the lives of these children tends to have a negative impact on the development of these skills, as fundamental motor skills must be practiced in order to be learned (Gabbard, 2000; Haywood & Getchell, 2002; Newell, 1984). Additionally, children who grow up in poverty tend not to have the environmental support for the development of fundamental motor skills (Goodway & Rudisill, 1997; Hamilton et al., 1999). Minority children who are growing up in poverty, therefore, face many challenges in being active and developing motor skills. Consequently, these children are in need of intervention.

Physical activity interventions are important, as physical activity can be an effective deterrent of many chronic diseases (USDHHS, 1996). Additionally, involvement in various types of physical activity programs can be beneficial for skill development, health benefits, and healthy lifestyle choices (Seefeldt & Ewing, 1997). Also highlighting benefits of participation in physical activity pursuits, Seefeldt and Ewing (1997) suggest that through sport children gain better health and social relationships, moral development, and are less likely to engage in delinquent and criminal behaviors than non-sport participants. Children who enjoy physical activity tend to be more active than children who do not enjoy activity. Sallis et al. (1999) determined that the three most important correlates of physical activity for children (grades 4-12) were use of afternoon time for activity, enjoyment of physical education, and family support of activity. Therefore, the instruction of FMS and the enjoyment of physical education are important.
Competence in the areas of perceptual motor integration, coordination, and balance may not only affect physical achievement, but also affect the academic achievement of young children (Kogan, 1982). Additionally, organized physical education seems to be beneficial to elementary school children, and the earlier the instruction is introduced, the greater the gains. Feldman (1988), in a 17-year longitudinal study, found benefits in overall achievement of children who were involved in early intervention programs that included a physical activity component. Others support this view (Cratty, 1986; Gallahue, 1987) and suggest additional structured early motor intervention programs.

Appropriate intervention in motor development addresses all aspects of movement (Gallahue, 1987). This would include object control activities, which depend on eye hand coordination and eye foot coordination. Experience and opportunity affect the development of OC skills such as striking, throwing, catching, kicking, dribbling, and rolling (Gallahue, 1987; Ulrich, 2000). The development of fundamental locomotor and object control skills as well as fitness, perceived competence, and physical activity knowledge are necessary and important outcomes for children from a lifetime physical activity perspective (NASPE, 1995). Given the motor skill delays that have been identified in children who are growing up in poor, urban environments, motor skill intervention is important through the implementation of quality physical education programming (Graham et al., 1998). These programs should include both developmentally and instructionally appropriate practices (COPEC, 1992, p.3).
Design of Effective Interventions

Developmentally appropriate practice recognizes the varied and individual capacities of children, and accommodates these characteristics within the instructional environment (COPEC, 1992). Instructionally appropriate practice considers what is currently known regarding best instructional practice through documented research (COPEC, 1992). Developmentally and instructionally appropriate teaching currently emphasizes such principles as provision of sufficient and suitable practice toward the learning goal, providing a variety of tasks for learner success, clearly communicating tasks and outcomes to learners, selection of critical elements and corresponding cues of performance, and encouraging students to develop at their own rate (Rink, 1994; Rink et al., 1991; Stroot & Oslin, 1993; Sweeting & Rink, 1999). Specifically, the physical education curriculum should be based upon goals and objectives that are appropriate for all children and be developed to include rhythms, dance, skills, concepts, and experiences designed to enhance physical as well as cognitive and social development (Graham et al., 1998). Children should be allowed the opportunity to practice skills and experiences at high rates of success, and activities should be based upon individual skill levels (Metzler, 1985). Siedentop (1983) suggested a match should be provided between student skill level and the task difficulty that would lead to a higher success rate and consequently higher motivation and esteem levels. Additionally, students are more likely to engage in mastery motivated learning when the tasks provided are interesting, meaningful, and relevant (Ames, 1992; Good, 1987; Valentini, Rudisill, & Goodway, 1999).
Teachers should select and clearly communicate specific cues related to the task goals for content presentation and teacher feedback statements (Rink, 1994; Werner & Rink, 1989). If the teacher has selected and presented these cues appropriately, there should be a direct relationship to the quality of student responses (Werner & Rink, 1989). Additionally, content development incorporating task and skill analysis for identification of patterns of movement, and arrangement of instructional tasks with clear progressions of scope and sequence should contribute to effective instruction (Stroot & Oslin, 1993; Rink et al. 1991). Providing multiple levels within tasks aids children in not becoming overly frustrated with tasks that are too difficult, but also in learning to challenge her/himself to find complex solutions. Student effort should be rewarded (Ames, 1992; Valentini et al., 1999).

Girls and boys should be provided equal access and opportunities to participate in activities of all types. Children should be encouraged, supported, and socialized to master goals and achieve success irrespective of gender (Graham et al. 1998). From a physical education perspective, Hutchinson (1993) encouraged teachers to examine their beliefs and expectations in order to help children make positive strides in the gymnasium. She suggests minimizing public comparisons of students, discouraging ability and gender grouping, maximizing fairness and cooperation, and promoting an equitable school environment for all students. Teachers who are aware of and utilize such procedures in motor skill instruction are likely to positively affect student learning and acquisition for both girls and boys (Rink, 1994; Rink et al., 1991; Sweeting & Rink, 1999).
Efficacy of Motor Skill Instruction

Early motor skill instruction seems to bring about positive changes in motor skill development of children (Goodway-Shiebler, 1994; Hamilton et al., 1999; Kelly et al., 1989; Valentini, 1997). Specifically, Goodway-Shiebler (1994), in an investigation of the motor skill development and sustained activity levels of African-American preschoolers who were at-risk, found that prior to a 12-week motor skill intervention both the intervention and the control groups of children (N = 59) evidenced FMS delays as detected by the TGMD. Following the 12-week intervention period of twice-weekly physical activity sessions, the group receiving the intervention demonstrated significant improvement in object control and locomotor motor skill performance while the comparison group did not. Prior to the intervention, the children receiving the intervention demonstrated locomotor skills at the 15th percentile and object control skills at the 16th percentile. The comparison group demonstrated the same skills at the 26th and 18th percentiles, respectively. Following the intervention, the children who received the intervention performed the locomotor skills at the 80th percentile and object control skills at the 79th percentile, while the comparison group demonstrated the same skills at the 26th and the 24th percentiles, respectively.

Kelly et al. (1989) found that typically developing preschool children (n = 21) demonstrated qualitative performance gains in fundamental motor skills as a result of two, 5-week instructional units. Following the intervention, the children who received the intervention demonstrated mastery of the horizontal jump at 44%, kick at 38%, strike at 40%, throw at 12%, catch at 33%, and roll at 45%. In contrast, the comparison group of preschoolers (n = 26) who engaged in well-equipped free play during the intervention
period demonstrated mastery of the horizontal jump at 25%, kick at 28%, strike at 29%, throw at 6%, catch at 5%, and roll at 35%. This group of children made no significant motor gains (Kelly et al., 1989). This study supported the use of structured early motor intervention programs for children; however, this study did not attempt to identify possible contextual factors impacting the motor performance of the participants, although the researchers did evaluate the participants for possible gender differences. No significant gender differences were evident at pre-intervention; therefore, the researchers did not consider gender as a variable in subsequent analysis, although the male participants demonstrated higher mean scores on all skills.

Also investigating the role of a motor development intervention, Valentini (1997) found that a 12-week student-centered or teacher-centered instruction program resulted in significant gains in FMS performance (measured by the TGMD) of kindergarten children (N = 37) who were developmentally delayed from pre-intervention (5th percentile of both groups) to post-intervention (84th percentile for student-centered, 75th percentile for teacher-centered). Interestingly, the comparison group of kindergarten children did not improve significantly, even though 30 minutes of physical education was provided daily to all three groups of children. These children demonstrated FMS at the 16th percentile prior to and the 37th percentile following the intervention period. Valentini (1997) did not, however, differentiate findings by gender.

Hamilton et al. (1999) found that prior to a motor skill intervention, preschoolers (N = 27) who were at-risk for developmental delay or academic failure demonstrated developmental delays in object control motor skill performance as measured by the TGMD. Specifically, the group of children who would receive the intervention performed
object control skills at the 19th percentile while the comparison group of children performed the same skills at the 17th percentile prior to the intervention. Following an eight-week parent-assisted motor skill intervention, significant pre-intervention to post-intervention gains in object control skills were evidenced for the intervention group who performed skills at the 67th percentile following the intervention, but not for the comparison group, who performed the same skills at the 15th percentile following the intervention.

As can be seen from the literature, preschool and kindergarten years are considered prime times for children to develop their fundamental motor skills (Seefeldt, 1980, 1982). In as little as eight weeks of instruction, significant gains can be attained in the performance of motor skills (Hamilton et al., 1999; Kelly et al., 1989). Many early childhood programs, however, focus upon cognitive, social, and fine motor instruction while limiting physical activities (Poest et al., 1989). Without motor skill intervention, children who are growing up in poor, urban environments may increasingly find themselves with motor skill deficiencies and physical activity disadvantages as compared with their peers. Although a number of studies have examined physical and motor development of elementary school-aged children, few have examined the development of FMS in preschool and kindergarten-aged children who are attending urban elementary schools (Poest et al., 1989). Fewer still have focused specifically upon object control motor skill development and examination of gender differences for these children, specifically, from a dynamical systems perspective.
Perceived Competence

Importance of Perceived Competence

Children who perceive themselves to be good at an activity or a skill tend to persist longer at and enjoy that activity more than children who perceive themselves to have poor skills (Ames, 1990, 1992; Harter, 1978; Nicholls, 1984). It is important, therefore, to consider children’s perceptions of activities as well as their actual abilities. A child’s perception of her skill level or ability in a task affects her motivation in performing the task, her emotional reactions, and her task performance. Each of these factors affects the outcome of the task performance (Ames, 1990, 1992; Weiss & Ebbeck, 1996). A child’s perception of her abilities within an educational situation can influence not only the tasks and the performance of those tasks, but also the types of goals that she chooses to pursue within educational situations (Ames, 1981, 1992). Social comparative information such as knowledge of how one performs related to others, and the contingent reward distribution such as praise or grades can influence not only how children evaluate their own abilities (Ames, 1981, 1995; Ames & Ames, 1981; Nicholls, 1984), but also the perceived causes of their success and failures (Ames & Ames, 1981; Duda & Nicholls, 1992; Nicholls, 1984). In physical education (PE) social comparisons and teacher expectations are often public, therefore, it is important for PE teachers to encourage mastery related goals where the focus is on individual improvement and task success, rather than performance related goals where the focus is on winning and being better than others (Martinek & Griffith, 1984).
In general, students who are motivated to master tasks tend to have an adaptive pattern of learning outcomes, whereas students who are motivated to be better than someone else tend to have maladaptive patterns which can be especially detrimental for low-achieving students (Ames, 1992; Nicholls, 1984; Theeboom et al., 1995).

**Development of the Perceived Competence Scale**

Bandura (1977, 1986) has conducted some of the most influential research in motivation, identifying self-efficacy as a major contributor to a child's persistence. Self-efficacy is defined as a situation-specific expectation or belief that one will be able to perform a specific task (Bandura, 1977). Harter (1978) identified another form of self-evaluation related to motivation, perceived competence, as emphasizing a child's perception of competence in a specific domain. Harter (1978) emphasizes that perceived competence is multi-dimensional and can be demonstrated by children through cognitive, social, and/or physical means. Young children (preschool and kindergarten aged) have been found to differentiate perceptions of competence in four areas including those of cognitive competence, peer acceptance, maternal acceptance, and physical competence (Harter, 1982).

Perceived competence is an important mediator of motivated behavior (Harter, 1978). Harter (1978) noted that children do not feel equally competent in every domain. That is, a child who perceives herself to be highly competent at cognitive tasks such as schoolwork and classroom performance, will not necessarily feel as competent socially, or report having lots of friends and being important in her peer group. Additionally, the combination of a child's high perceived competence regarding an activity, and an internal perception that the child can control the outcome of that activity enhances that child's
perceived competence and intrinsic pleasure regarding that activity (Harter, 1978). On the other hand, if a child has low perceived competence regarding an activity and also believes that the outcome of the activity is out of her/his control, that child is not likely to be motivated by or enjoy the activity (Harter, 1978).

Harter (1982) developed the Pictorial Scale of Perceived Competence and Social Acceptance (PSPCSA) in order to determine the relationship between children’s perceived competence and children’s motivational orientation to be curious, to prefer challenge, and to attempt to master tasks rather than engage in tasks in order to win or beat others (Harter, 1982). Harter’s (1978, 1982, 1988) research on motivation and perceptions lead to the development of her motivational framework emphasizing perceived competence. The original model, designed for children aged 8-12, is viewed as domain specific and includes measures of perceived cognitive competence, perceived social competence, and perceived physical competence (Harter, 1978). Harter (1982) determined that children were able to engage in behaviors based upon perceptions of competence before reaching the age of eight years old. Based upon this work, Harter and Pike (1984) developed the PSPCSA for young children. This scale is developmentally appropriate and allows preschool and kindergarten children to communicate their perceptions of competence in the four domains of Perceived Cognitive Competence, Perceived Physical Competence, Perceived Peer Acceptance, and Perceived Maternal Acceptance (Harter & Pike, 1984). Each subscale consists of six items that are presented visually, one item per page. Each item is presented by two side-by-side pictures of one child who appears competent at the item, and another who does not appear competent. Additionally, the PSPCSA for young children employs a question format designed to reduce a child’s tendency for socially desirable responses.
The perceived physical competence subscale consists of items including tying shoelaces, swinging, climbing, running, hopping, and skipping. Reliability for internal consistency of the individual subscale ranges from .65 to .89, with a reliability of .86 for the combined subscale measure. Although this study only employed the perceived physical competence subscale, the reliability for the total scale is .89 (Harter & Pike, 1984). The PSPCSA for Young Children was validated on 90 preschool and 56 Kindergarten children who were Caucasian (96%), African-American, Hispanic, and Asian (the remaining 4%, collectively). Harter has developed PSPCSA picture plates that are gender specific and reflect a variety of ethnic groups.

Influence of Perceived Competence

Perceived competence can be thought of as the motivation to participate or continue in an activity based upon how an individual perceives his/her capability in that activity (Harter, 1978). Perceived competence in activity may influence persistence, motivation, effort, expectations, and ultimately, performance (Good, 1987; Martinek & Griffith, 1984; Weiner, 1985). According to Harter (1978, 1982, 1988), the development of perceived competence is dependent upon four psychological constructs including past experiences, difficulty of challenge associated with the task or performance, reinforcement and personal interactions with significant others regarding the task or the performance, and intrinsic motivation (Harter, 1978).

Achievement motivation research has suggested that perceived competence affects motivation, and therefore, behavior (Ames & Ames, 1981; Ames & Archer, 1988; Nichells, 1984). To illustrate Harter’s (1978) constructs, a child who has a history of fun and is relatively successful activity engagement is more likely to feel good about his/her
physical abilities than is a child who has not had many or successful experiences (Ames, 1992; Ames & Ames, 1981). When tasks are perceived as difficult, a child who has had positive past experiences tends to persist at and is motivated to master the task. A child who has not had past success, on the other hand, is more likely to discontinue participation and have negative feelings regarding his competence (Ames, 1981, 1992; Ames & Ames, 1981). Regarding reinforcement, when competitive situations or a focus on products are emphasized, children have been found to engage in ego-involved comparisons in which his/her success depends upon the failure of another child (Ames, 1995; Nicholls, 1984; Theeboom et al., 1995). Competitive environments may lead to critical social comparisons and negative social behaviors such as aggression, cheating, and obstructing another’s progress (Ames, 1981, 1992, 1995; Ames & Ames, 1981). In such situations, children tend to perceive success as a product of superior ability (Duda & Nicholls, 1992; Weiss & Ebbeck, 1996). On the other hand, when mastery situations (in which the goal is gaining knowledge rather than winning) or a focus on processes is emphasized, children have been found to develop high self-esteem, high achievement, and intrinsic motivation (Ames, 1990, 1992; Ames & Ames, 1981; Nicholls, 1984; Weiss & Ebbeck, 1996). In mastery situations, children tend to attribute their success to effort rather than to natural ability or other uncontrollable causes (Nicholls, 1984; Weiner, 1985; Weiss & Ebbeck, 1996).

Studies that have investigated the role of perceived competence in motor performance and/or physical activity (Goodway & Rudisill, 1996; Rudisill, 1989; Theeboom et al., 1995; Weiss, Bredemeir, & Shewchuck, 1986) have confirmed the relationship between perceived competence and motivated activity behavior. Specifically,
Rudisill (1989) investigated the role of goal setting orientations on the perceived competence of college-aged students enrolled in a college activity course. The results revealed that students who set goals for individual improvement were more likely to positively impact their perceived competence for that activity than were students who did not set goals. Weiss et al. (1986) suggested that children who have high levels of perceived competence will attempt to engage in tasks that are more challenging and develop a sense of internal control and ability. Additionally, these authors conclude, along with Harter (1978), that children with high self-esteem and perceived competence will persist at tasks longer and try harder to solve complex problems than will children with lower perceived competence and self-esteem (Weiss et al., 1986).

Theeboom et al. (1995) conducted a study to investigate the influence of motivational climate on 8-12 year old children’s perceived competence in sport. These authors found no significant differences between a three-week mastery-based climate and a traditional teaching climate on perceived competence, however, the authors qualitatively concluded that the children in the mastery-based climate communicated higher levels of enjoyment and perceived competence as compared to the children in the traditional climate. Finally, investigating the influence of a motor skill intervention on the perceived competence of young children, Goodway and Rudisill (1996) found that a 12-week motor skill intervention significantly enhanced the perceived physical competence of preschool-aged, African-American children who were disadvantaged.

Collectively, these studies support the notion that perceived competence is an important mediator of motivated behavior in activity. Children with high perceived competence are more likely to enjoy and engage and persist in activities, whereas
children who do not feel competent tend to avoid and/or not persist in activities (Harter, 1978; Weiss et al., 1986). Additionally, the relationship between perceived physical competence and motor development appears to be linear (Goodway & Rudisill, 1996).

Concerns Regarding Children who Live in Poverty

There has been national concern regarding the growth and development of children who are in poverty by current programs and initiatives (AECF, 2001; USDHHS, 1996, 2000). National data reveals that 16% children growing up in Ohio grow up in poverty (AECF, 2001). From 1990-1998, Ohio's rate of children living in families with parents who do not have full time, year-round employment surpassed the national average of 26%, to reach 28% (AECF, 2001). Currently, the number of children living in single parent homes in Ohio is equivalent to the national average of 27%, and the percent of children living with single mothers receiving child support or alimony is above the national average of 34% at 39% (AECF, 2001). The rate of Ohio children who are living in extreme poverty, (income below 50% of poverty level), is the same as the national average of 8%, and Columbus is ranked 19th of 50 large cities nationally on this measure (AECF, 2001). In 1997 and 1998, the number of births to mothers who reported receiving late or no prenatal care was more than double the number in 1996, and ranked 6th of 50 large cities nationally. The percent of Columbus mothers in the labor force with children under age 6 in 1990 was 62% as compared to 59% in the nationally (AECF, 2001). The percent of Columbus children under age 15 living in distressed neighborhoods in 1990 was ranked 19th of 50 large cities, at 15% (AECF, 2001). From these statistics, it can be concluded that many children growing up in Ohio are exposed to environments that may be detrimental to their development, including their motor skill development. In an effort
to counter some of the aforementioned effects, preschool programs for children raised in
such environments have emerged over the last two decades. Often, their poverty status
and the presence of risk factors in their lives identify children served by these programs.

Risk factors in a child's life can be processes, events, or characteristics that increase
the probability that problems will occur (Kazdin, 1995). Risk factors tend to be additive
in nature; that is, the presence of one risk factor increases the probability that other risk
factors will accumulate. Risk factors can be categorized as child factors, family factors,
school factors, and other factors (Kazdin, 1995). Child factors may include fussy,
difficult child temperament; neurophysiological factors such as problems with balance,
coordination, speech, hearing, etc.; premature birth; chronic childhood illness; and
developmental deficit/delay (Kazdin, 1995). Family factors may include socio-economic
disadvantage, genetic loading, criminology/psychopathy in the family, birth order,
crowded living arrangements, child-parent interaction difficulties, disinterest of parent,
single parent family, marital conflict in the home, drug/alcohol abuse in the home, unsafe
surroundings, and abuse/neglect (Kazdin, 1995). School factors may include poor setting,
poor climate, poor child-teacher interactions, overcrowded classroom environment, poor
peer relations, reduced access to school programs, and academic/intellectual difficulty
(Kazdin, 1995). Other factors are interaction variables not accounted for such as parent
physical, social, or cognitive disability; depression of parent; negative role models; and
poor parental monitoring (Kazdin, 1995). Young children who are exposed to
environmental risk factors may be more likely to demonstrate developmental delay or
educational failure (Public Law 105-117, Part C & H, 1997).
One of the major risk factors for children is poverty, which tends to be associated with other risk factors such as poor supervision, poor nutrition, and reduced access to public programs and services (Kozol, 1991; Sallis et al., 1993). Poverty also tends to be associated with physical inactivity. National data indicates that physical activity rates decrease as income level decreases, and that children from poor, urban families face many challenges to lead a physically active lifestyle while striving to overcome the burden of poverty (USDHHS, 1996; 2001). In fact, poor and minority populations have been targeted by the Center for Disease Control and Prevention because they appear to be under-served by current physical education programs, and demonstrate significant needs both as children and as adults (USDHHS, 1996; 2001).

As educators strive to meet the needs of students who are growing up in poor, urban environments, information regarding the motor skill development of young children who are attending urban elementary school may provide insight to curricular concerns. Additionally, educators need effective motor skill programs to remediate the developmental delays often found in these populations. For these reasons, as well as a nationally renewed focus on public health and physical activity, it is important to examine ways in which FMS such as object control skills can be enhanced.

Learner Characteristics

Knowledge of learner characteristics is essential in understanding development (Newell, 1984). Factors such as skill level and physical fitness can influence motor development. Children who are skilled and fit tend to seek out opportunities to engage and persist in physical activity more often than their less skilled and fit peers (Fox, 1997; Welk, 1999). Measures such as body mass index (BMI) and grip strength are commonly
used to assess physical fitness (Baumgartner & Strong, 1994). Knowledge of BMI is valuable, as it is related to body fatness and corresponding future health risks (Payne & Isaacs, 2002). Grip strength can be used as an indicator of overall body strength, which necessarily impacts both the amount and type of activities in which a child is able to successfully engage (Haywood & Getchell, 2002). Additionally, a child’s gender may substantially affect a child’s motivation, persistence, skill level, and success (Garcia, 1994; Fox, 1997).

**Gender**

Beginning in infancy, adults have different expectations for boys versus girls and create different environments for them (Berk, 2000). Parents and teachers tend to reinforce stereotypical gender-appropriate types of behaviors in children from an early age (Berk, 2000). The home, school, and neighborhood environments provide children with many opportunities to observe gender-appropriate behaviors and practices (Berk, 2000). Many parents socialize female children to be compliant, dependent, emotionally sensitive, and to engage in quiet, cooperative types of games. Male children are often expected to be more rambunctious, loud, independent, and play games of physical contact and competition. When male children engage in externalizing types of behaviors such as shouting, defiance, fighting, etc., parents and teachers are more likely to ignore or overlook these behaviors than if female children engage in them (Berk, 2000; Kazdin, 1995). Additionally, when girls “act-out” they are more likely to be reprimanded by parents and teachers than are boys engaging in similar behaviors (Kazdin, 1995). Hormonal differences between males and females may also contribute to internalizing (female) / externalizing (male) types of behavior patterns (Berk, 2000).
The type and amount of play a child engages in is thought to be mediated by a combination of environmental (social) and biological (hormonal) factors (Berk, 2000; Pellegrini & Smith, 1998). Eccles and Harold (1991) found that parents of female children placed less importance on involvement in sport than did parents of male children. Male children also were found to receive more encouragement and support for engaging in physical activity than were female children (Brastad, 1993). Furthermore, Brustad (1993) found that perceived physical competence was higher in boys than in girls. In essence, expectations and socialization may have a significant influence on the activity choices of children. From relatively young ages, boys have been found to report more favorable attitudes toward and enjoy exercise more than girls, suggesting that physical activity and exercise is regarded as more gender-appropriate for boys than for girls (Brustad, 1996). Girls have been found to prefer fine motor activities and games involving language, while boys tend to prefer physical gross motor activities and spatial play (Berk, 2000; Pellegrini & Smith, 1998). Thus, given the differing socialization factors for boys and girls (Berk, 2000; Brustad, 1993; Garcia, 1994; Pellegrini & Smith, 1998), the gender differences found in object control skills (Ulrich, 2000) and perceived physical competence (Rudisill, Mahar, & Meaney, 1993), it seems appropriate and important to examine gender as a variable of interest.

Summary

From a dynamical systems perspective, motor skill development evolves through the coordination of multiple subsystems. Motor skill development is complex, dynamic, and environmentally sensitive. Actual motor skill development as well as perceptions of skills may affect continued participation in and enjoyment of a variety of physical
activities. Young children who are growing up in poverty bring unique characteristics to the learning environment, which affect the acquisition of motor skills including object control activities. Information regarding the motor skill development of young children who are attending urban elementary schools may aid educators in meeting the needs of this population, as motor developmental delays are often found in young children live in poor, urban environments. For these reasons, as well as a nationally renewed focus on public health and physical activity, it is important to examine ways in which FMS such as object control skills can be enhanced for girls and boys who are attending urban elementary schools by educational programs and initiatives.
CHAPTER 3

METHODS AND PROCEDURES

Chapter three outlines the theoretical framework used to guide this study as well as the methodology and procedures employed by this study. Initially, the theoretical framework is reviewed. Next, the research design and variables in the study are explained. The context for the study as well as participant selection and description of participants is provided in subsequent sections. The following sections provide information regarding the instrumentation and research procedures, as well as the actual intervention details. The final section describes the data analysis and corresponding statistical procedures.

Theoretical Framework

From a dynamical systems perspective, interacting factors from 1) the environment, 2) the organism (child), and 3) the task (object control activities) work to constrain (shape) development (Newell, 1984). Unique factors within each of these three contributors may combine to produce effective or ineffective movements leading to task success or failure. It is therefore important to consider each of these three categories in the development of a motor skill intervention.

Fundamental motor development does not occur automatically, and is influenced by cooperating subsystems (Gallahue, 1981). Many theories of development have emerged over the years, but few have considered the interaction of contextual variables as the dynamical systems theory (DST). A dynamical systems perspective emphasizes the
importance of all systems in contributing to a particular behavior or pattern of behaviors (Thelen & Ulrich, 1991) rather than reliance on a single subsystem. Each subsystem has its own path and rate of development, and subsystems are free to assemble, producing many possibilities of movement and many degrees of freedom (Thelen, 1985).

Many degrees of freedom (possible movement forms) are conceivable in human movement. Each cooperating subsystem involved in specific movements increases the possible degrees of freedom within that movement pattern. The performer must then find ways to reduce the degrees of freedom in order to execute the desired movement pattern. For instance, the more specialized the movement, the less room for error in performance. Due to the specific patterns involved in the development of specific motor behaviors such as those of object control skills, degrees of freedom within the task subsystem are reduced, thus offering little variance of movement (Roberton, 1978). The resulting pattern of movement is referred to as a dynamical attractor state, and this attractor state will be stable to the degree that the cooperating subsystems continue to interact in a certain manner (Thelen & Ulrich, 1991). These subsystems are driven to self organize to produce stability in movement. When the organism (person) is driven to a new attractor state or pattern of movement, a control parameter initiates a perturbation, causing the system to move from an old inefficient form of movement to a new, more stable and efficient form. This is what dynamical systems theorists refer to as a phase shift (Thelen & Ulrich, 1991).

Different individuals have differing interacting subsystems. Some of these subsystems might include genetics, coordination, experience, strength, and motivation. An individual in a stable attractor state is able to demonstrate consistent stable movement
with few degrees of freedom. The limited degrees of freedom within the movement pattern offer little variance of movement. An individual experiencing a phase shift or transition to a new attractor state, however, has many more degrees of freedom, which provide more variance in movement. This individual is much less likely to experience accuracy or stability of movement. Highly skilled performers typically demonstrate stable patterns of movement with reduced degrees of freedom. Less skilled performers exhibit wider variability in movement with more degrees of freedom. It is possible for teachers, through instruction or other environmental means to perturb phase shifts (and reduce degrees of freedom) by using strategies such as teaching cues, modeling, different equipment, etc.

Regarding phase shifts, if one or more of the subsystems is unwilling or unable to cooperate in the phase shift, that subsystem is called a rate limiter. This rate limiter will prevent the system from assembling into a new pattern of movement (Thelen & Ulrich, 1991). This notion is of particular interest due to the nature of atypical development. The environmental subsystem of atypically developing children may have a detrimental affect on their motor development (Roberton, 1978). Children who are not able to lead physically active lifestyles, for example, have not been able to practice and therefore able to reduce the degrees of freedom required in the performance of many fundamental motor skills.

From a DST perspective, transit toward mature movement develops through patterns of immature stability, moving to more mature instability, and finally mature stability. In essence, it is the process of destabilization to stabilization of movement that depends upon the cooperation of the many subsystems of an organism.
Subsystems involved in performance of object control skills may include organismic (learner), task-related, and environmental (Windle & Lerner, 1986) subsystems. In order to understand the complex interactions among characteristics of the learner, the task, and the environment, this study seeks to provide insight regarding learner and environmental variables as well as possible task and environmental modifications.

Design

This study used a pretest-posttest, quasi-experimental, non-equivalent control group design. The experimental group of children was drawn from a school that was referred to as the intervention group, and consisted of two intact classes (one preschool and one kindergarten). A comparison group of children drawn from a school considered to represent an appropriate comparison also contained two intact classes of children (one preschool and one kindergarten). Rather than a true experimental design featuring randomization, a quasi-experimental design was utilized because classrooms of children form intact groups that ethically and practically should not be disrupted for a study (Ary, Jacobs, & Razavieh, 1990).

*Independent, Dependent, Organismic, and Confounding Variables*

The independent variable for this study was an eight-week object control motor skill intervention, which was administered to the intervention group. The primary dependent variable was object control motor skill performance. A secondary dependent variable was perceived physical competence. Organismic variables included gender, age, ethnicity, and risk factor information, as well as grip strength and body mass index (BMI). Variables that the researcher did not attempt to, or could not control may have
potentially acted as confounding variables. Examples of such variables might include any activity practice outside of school, teacher characteristics, school performance, and/or disability.

Context of the Study

This study was conducted in a large multi-ethnic city in an urban school district in the mid-western United States. Two schools of participants were involved in the study. Schools serving intervention and comparison groups demonstrated similar demographics, and were both AAA schools. Each school serves a diverse student body consisting of approximately 200 students from preschool to 5th grade. One hundred percent of the students attending the intervention school receive free lunch and ninety-six percent of children attending the comparison school receive free lunch. According to teacher report, many of the students attending these schools come from single-parent homes, and/or live in governmental (project) housing. The intervention school’s student mobility rate is 17%, and the comparison school’s student mobility rate is 12.5% (Ohio State Department of Education [OSDE], 2002). Both schools are in a state of academic emergency, each having met only 5 of the 27 state performance indicators during the 2000-2001 school year (OSDE, 2002).

In addition to their regular school routine during the school day, the intervention groups received a physical activity intervention twice per week, 45 minutes per session, over eight consecutive weeks at the beginning of the 2001-2002 school year. The comparison groups participated in their regular school routine.
Selection of Participants

Participants were purposely selected from two similar schools in urban settings. These schools were identified as serving preschool children eligible for compensatory programming by the Ohio State Board of Education for the 2001-2002 school year, and were located within a 15 mile radius of The Ohio State University. Specific demographics of participants can be seen in Table 3.1.

Intervention Group Participants

The intervention group consisted of two intact classrooms of children, one preschool (n = 19) and one kindergarten (n = 27). Preschool participants were enrolled in compensatory school programming. Children eligible for compensatory services under this program must be between the ages of 3 and not age eligible for kindergarten (age 5 on or before September 30). Children from families whose income is 100 percent or below the poverty level attend tuition free. All participants attended a typical school day program, consisting of play in centers (e.g. manipulation, reading, art, etc.), circle time (songs, numbers, story time, alphabet, etc), and desk work (writing, math, etc.). Certified preschool and kindergarten teachers provided classroom instruction. Participants were provided a 30-minute recess following lunch. Recess was non-structured and typically held outside on a blacktop surface with limited equipment available. When heavy rain prevented the children from outdoor recess, classroom teachers provided board games and seat-activities in the regular classroom. Additionally, regular physical education was provided by a certified PE teacher to the kindergarten classes once per week for 30 minutes.
Comparison Group Participants

The comparison group consisted of two intact classrooms of children, one preschool (n = 18) and one kindergarten (n = 33). Preschool participants were also enrolled in the same compensatory school programming. As the preschool program and curriculum was standardized within the school district, all participants attended the same school day program as the intervention group. This program consisted of play in centers (e.g. manipulation, reading, art, etc.), circle time (songs, numbers, story time, alphabet, etc), and desk work (writing, math, etc.). Certified preschool and kindergarten teachers provided classroom instruction. Participants were also provided a 30-minute recess following lunch. Recess was similar to that of the intervention group. Additionally, all participants in the comparison condition were involved in regular physical education, provided by a certified PE teacher, once per week for 30 minutes. Table 3.1 provides specific gender, age, ethnicity, risk factor indication, BMI and grip strength information regarding all participants, as well as by group.
<table>
<thead>
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<th>COMPARISON</th>
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<td>28 M</td>
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<td>%</td>
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<td></td>
<td>%</td>
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</tr>
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<td>%</td>
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</tr>
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<td><strong>INTERVENTION</strong></td>
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<td><strong>COMPARISON</strong></td>
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<td><strong>BODY MASS INDEX</strong></td>
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<td></td>
</tr>
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<td>9.33 T</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
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<td>9.33 T</td>
<td>2.88 T</td>
</tr>
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<td>8.89 M</td>
<td>3.26 M</td>
<td>10.25 M</td>
<td>2.94 M</td>
</tr>
</tbody>
</table>

**Note:** T = Total, F = Female, M = Male

Table 3.1: Specific Demographics of Participants
Instrumentation

Data were collected in the following areas: object control motor skill performance, perceived physical competence, body mass index, grip strength, and risk factor indication. The total battery of tests took approximately 32 minutes per child, and was administered during two separate pre-intervention days prior to the intervention period and two separate post-intervention days following the intervention period. All testing was videotaped using a Panasonic camera operated by a Ph.D. candidate in the Adapted Physical Education area of study. This research assistant was familiar with the TGMD-2 instrument and had prior experience coding TGMD-2 data from videotaped testing sessions. This assistant was, therefore, knowledgeable and effective in videotaping children for TGMD-2 data analysis purposes. Table 3.2 provides a summary of instrumentation utilized in this study.
<table>
<thead>
<tr>
<th>Test Instrument</th>
<th>When Assessed</th>
<th>Data Collected</th>
<th>Administration Time *</th>
<th>Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test of Gross Motor Development-2, Object Control Subscale**</td>
<td>Pre-intervention, Post-intervention</td>
<td>Raw score (0-48),</td>
<td>15 minutes</td>
<td>Primary Researcher</td>
</tr>
<tr>
<td>Pictorial Scale of Perceived Competence and Social Acceptance, Physical Competence Subscale**</td>
<td>Pre-intervention, Post-intervention</td>
<td>Raw score (6-24), Composite score (mean of raw score, 1-4)</td>
<td>10 minutes</td>
<td>Primary Researcher</td>
</tr>
<tr>
<td>Grip Strength**</td>
<td>Pre-intervention, Post-intervention</td>
<td>Highest score of four trials recorded in pounds per square inch.</td>
<td>2 minutes</td>
<td>Primary Researcher</td>
</tr>
<tr>
<td>Body Mass Index**</td>
<td>Pre-intervention, Post-intervention</td>
<td>Weight in kilograms divided by the square height in meters.</td>
<td>5 minutes</td>
<td>Primary Researcher</td>
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<tr>
<td>Risk Factor</td>
<td>Week 6 of intervention period</td>
<td>Total number of factors as indicated on worksheet (0-27)</td>
<td>10 minutes</td>
<td>Classroom Teachers</td>
</tr>
</tbody>
</table>

Note: *Administration time per participant. **Included in participant test battery, which constitutes 32 total minutes

Table 3.2: Summary of Instrumentation
Ulrich’s (2000) Test of Gross Motor Development-2 (TGMD-2) quantitatively assesses the fundamental motor skill performance of children 3-10 years of age. The TGMD-2 has two subtests measuring object-control skills and locomotor skills. For the purposes of this study, only object control skills were assessed. The object control subscale (Appendix A) was utilized to assess six object-control skills (strike, stationary dribble, catch, kick, overhand throw, and underhand roll). Each skill includes three to five criterion elements of form, which represent a mature pattern of the skill. If a participant demonstrates the element correctly, she/he receives a mark of “1”. Two tries of each skill are provided, and the participant receives credit for each try. Following this procedure, the examiner totals the scores of the two trials for each skill and assigns a raw score total. The lowest possible raw score for the object control subscale is zero, and the highest possible raw score is 48. Raw scores are numeric representations of participants’ overall performance on object control skills. High scores indicate well-developed skills, whereas lower scores indicate absence of the criterion elements of form. Descriptive as well as numerical ratings can be assigned once raw scores are converted into percentile ranks and standardized scores. Percentile ranks are based upon the participant’s raw score, gender, and age. Ranks between the 25th and 75th percentile indicate “average” performance (Ulrich, 2000). Standard scores are deviation standard scores based upon the cumulative frequency distributions of the raw scores of children in the TGMD-2 standardization sample.
Standard scores are useful for comparative analyses, as age and gender are factored into the resulting score. A child with a standard score between 8-12 is considered an “average” performer (Ulrich, 2000).

Ulrich (2000) reported internal consistency reliability coefficients for children aged 3-10 of the TGMD-2 object control subscale all reached or exceeded .87 in magnitude. Test-retest reliability coefficients for the same children all reached or exceeded .84 in magnitude. Content validity for the TGMD-2 was established by having three independent content experts review and accept items. Construct validity has been established through item and factor analysis methods (Ulrich, 2000).

Standardized testing procedures were followed according to TGMD-2 guidelines, and equipment was standardized for each participant (Appendix A). The primary researcher, a Caucasian female, administered all testing. The object control subscale administration took approximately 15 minutes per child, and a trained research assistant videotaped all trials for all participants. Pre-intervention data were collected during the first week of the public school year, prior to the intervention period. Post-intervention data were collected during the week following the intervention period.

*The Test of Gross Motor Development-2 Inter-rater and Intra-rater Reliability*

The primary researcher coded results from a videotaped recording of the test. A trained, independent rater (blind coder) was utilized, in order to obtain inter-rater reliability. This independent-rater was a Ph.D. candidate in the area of Adapted Physical Education, and had extensive prior experience in administration, coding, and interpretation of the TGMD and TGMD-2 instrument.
The independent-rater was initially trained in the use of the TGMD in her pre-doctoral studies, and trained in the use of the TGMD-2 in her doctoral-level motor development class. Additionally, the independent-rater had implemented the TGMD-2 in her profession.

Cooper, Heron, and Heward (1987) suggest that inter-rater reliability can be reported for a pre-established percentage of sessions. These authors posit that 20% of sessions is acceptable, and thus, the independent rater for this study observed and coded 20% of the pre-intervention data (18 participants) and 20% of the post-intervention data (15 participants). Coefficients were obtained by dividing the number of agreements by the sum of the number of agreements minus disagreements, and multiplied by 100. This coefficient was determined for each group at pre-intervention, and for each group at post-intervention. The inter-rater reliability coefficient was $r = .98$ for pre-intervention data. At post-intervention, the coefficient was $r = .96$. Following the coding of each group of participants, the researcher randomly selected ten participants. On a new coding sheet, the researcher then re-coded the performance of these participants. Re-coding was then compared with original coding. An intra-rater reliability coefficient was obtained by dividing the number of agreements by the sum of the number of agreements minus disagreements, and multiplied by 100. The intra-rater reliability and consistency was $r = .96$.

*Pictorial Scale of Perceived Competence and Social Acceptance*

Perceived physical competence measures were utilized as indicators of students' perceptions of her/his own physical abilities. The Harter and Pike (1984) Pictorial Scale of Perceived Competence and Social Acceptance (PSPCSA) for preschool and
kindergarten children was used to assess perceived physical competence. The ethnic version of the PSPCSA used was matched to the ethnicity of the child being assessed. PSPCSA ethnicity templates include African-American, Asian American, Caucasian, and Mexican-American. Additionally, the gender of the child was matched to the gender-specific version of the PSPCSA.

The PSPCSA contains four different subscales (cognitive competence, physical competence, peer acceptance, and maternal acceptance), but only perceived physical competence (Appendix B) was assessed. The perceived physical competence subscale consists of six pictorial items (swinging, climbing, tying shoe laces, skipping, running and hopping) represented by pictures that measure a child’s perceptions of his or her own physical competence. Each item contains two separate pictures side by side. One picture depicts a child who is competent at the task, and the other depicts a child who is not as competent at the same task. The participant is asked to indicate the picture that is most like him or herself. The participant is then asked to focus on the chosen picture and indicate whether he or she is just a little bit like that child, or a lot like that child. Scoring for each item is on a four point scale, and is as follows: If a child chooses the poorly skilled child who is “a lot” like him/her, one point is assigned; if a child chooses the poorly skilled child who is “a little” like him/her, two points are assigned; If a child chooses the skilled child who is “a little” like him/her, three points are assigned; and if a child chooses the skilled child who is “a lot” like him/her, four points are assigned. Each subscale includes six items, therefore raw scores range from 6-24 points. Subscale raw scores are then averaged and this composite subscale score serves as part of a child’s profile of perceived competence (ranging from 1-4).
The version of the scale used in this study was the preschool-kindergarten scale. Harter and Pike (1984) reported that the original preschool-kindergarten scale was tested on 90 preschool and 56 kindergarten children, with a resulting mean of 3.2 (SD=0.49) for the perceived physical competence subscale. Reliability for internal consistency of the perceived physical competence subscale was reported at .87.

A standardized protocol (Appendix B) was followed for each participant, and test administration took approximately 10 minutes. Pre-intervention data were collected during the week prior to the intervention period. Post-intervention data were collected during the week following the intervention period. The PSPCSA was scored concurrently by the administrator as the participant indicated her/his choices.

**Grip Strength**

Maximal grip strength was measured using a standard handgrip dynamometer assessment instrument. Prior to the trials, the handle was adjusted to the size of the participant’s hand, and the task was demonstrated for each participant. The participant was then asked to use their “favorite” hand to grip the dynamometer and “try to squeeze the handles together as hard as you can.” Two trials were also assessed with the child’s non-dominant hand, totaling four trials. The highest resultant grip strength score (in pounds per square inch) was recorded as a general indicator of overall strength (Baumgartner & Strong, 1994). Test administration was standardized for each participant, and took approximately 2 minutes.
Body Mass Index

Body composition measures were administered using a body mass index (BMI) for height and weight. The BMI score was used as an indicator of healthy ranges of height/weight measures. Height without socks or shoes was measured to the nearest 0.1 cm. using a standard stadiometer. Height was measured with the participant placing his/her back against the wall, standing with her/his shoulders and heels as close to the wall as possible, and then measuring the crown of the head with the stadiometer.

Weight without shoes was measured to the nearest 0.1 kg for each participant with the participant standing in the middle of an electronic scale. Height and weight measures were converted into a BMI by dividing body weight (in kilograms) by the square of the person’s height (in meters). For example, if a child weighs 56 pounds (25.4 kg.) and is 4 feet tall (1.219 m.): 25.4 X (1.29 squared) = 25.4 X 1.4859 = 7. Therefore, this child has a BMI of 17. The mean BMI score range for females aged 5-6 years is 15.6-15.7, and for males of the same age, 15.6-16.0 (National Center for Health Statistics, 1987). Test administration was standardized for each participant, and took approximately 5 minutes.

Risk Factor Data

Classroom teachers for each participant completed a worksheet measuring child risk factors (Appendix C). Child risk factors were assessed using a checklist of indicators of at-risk status developed by the Office of Compensatory Programs at the Michigan Board of Education. During week 6 of the intervention period and following the completion of a required visit to the home of each child in her classroom, classroom teachers were asked to complete the checklist (Appendix C) for each child in her/his classroom.
The total number of risk factors indicated on the checklist was recorded for each child. Completion required approximately 10 minutes per child. An instrumentation summary is provided in Table 3.2.

Field Notes

In order to give depth to the findings of this study, anecdotal notes were recorded by the primary researcher during the intervention period. As the primary researcher monitored activity in the three stations provided each day, she noted the progress of the participants during their activities. Notes were recorded for 8 of the 16 intervention sessions. Of particular interest to the primary researcher were the child responses to the activities provided and participation patterns of the participants, especially differences in participation between genders. In addition to the handwritten notes, the primary researcher also made mental notes about the intervention.

Procedures

The object control subscale, the perceived physical competence subscale, grip strength, and BMI were administered individually, on two separate testing dates, to each participant by a trained Caucasian female (primary investigator) prior to beginning the intervention. The tests were administered in the gymnasium away from distractions. A standardized test protocol was used to administer each test. Time to administer the object control subscale of the TGMD-2 was approximately 15 minutes per child, and was administered on the first testing day. During the second testing day, perceived physical competence testing took approximately 10 minutes per child. Grip strength, and height and weight for the BMI were assessed immediately following perceived physical competence, and required an additional seven minutes per child. Object control and
perceived competence measures were administered again as post-intervention measures to the intervention and the comparison groups following the eight-week intervention. Risk factor information was collected only once. The teacher of each participant completed risk factor information during week six of the intervention period. This instrument required approximately 10 minutes per child.

**Informed Consent**

Informed consent was obtained from the custodial caregiver(s) of each child prior to participating in the study (Appendix D). Assent was obtained from each child by verbally asking the child in his/her native language if he/she would like to participate in a “physical education class”. Assent from all children was indicated by a positive response to this question. The teacher and aids of the participants were also asked to consent to the study. Prior to the investigation, human subjects approval was obtained from the Institutional Review Board (Appendix E), school district (Appendix F), and schools (Appendix G, H).

**Object Control Motor Skill Intervention**

Research in early intervention of motor development has demonstrated that significant improvement can be obtained in eight weeks of activity instruction (Conner & Dummer, 1993; Hamilton et al., 1999; Kelly et al., 1989). The current study aimed to implement an eight-week object control motor skill intervention.

The intervention group participated in an eight-week, 45-minute object control skill intervention twice weekly as a part of their regular school program. Intervention sessions were typically on Mondays and Wednesdays, however, one Wednesday was missed due to a special program, and so the children received a make-up session (a
Monday) as the last intervention session. The attendance rate for children in the intervention group during the intervention was 93%. Individual make-up sessions for children who were absent during the intervention period were not provided.

The participants in the preschool intervention class participated in the intervention in the morning following breakfast, song-circle time, and a tooth-brushing break. Had the intervention not been provided, this group would have participated in a free-play activity in the gym, monitored by the preschool teacher and aids. Participants in the kindergarten intervention class received the intervention following breakfast. Had the intervention not been provided, these children would have engaged in group song activities within the kindergarten classroom.

Protocol for the intervention consisted of a group exercise warm-up (10 minutes) and three skill rotations of 10 minutes, with an average of a 1:5 teacher to student ratio. One or two teachers taught at a single station, with the number of students ranging from 4-8. Total minutes for each skill was as follows: strike- 80 minutes, dribble- 80 minutes, catch- 80 minutes, kick- 80 minutes, roll- 80 minutes, and throw- 80 minutes. Table 3.3 shows the allocation of instructional time by skill over the eight-week intervention. The remaining 5 minutes of each class served as rotation time buffer. The comparison groups participated in their regular school program during the intervention period, and received the intervention during the quarter following the intervention period for this study.
<table>
<thead>
<tr>
<th>Session</th>
<th>Strike</th>
<th>Dribble</th>
<th>Catch</th>
<th>Kick</th>
<th>Throw</th>
<th>Roll</th>
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<tr>
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<tr>
<td>*Total</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 3.3: Allotment of Instructional Time for Object Control Skills
Intervention Development

Activities were designed using a developmental task approach of each task reflecting the participants' current level of development. Typical efficiency levels with corresponding cues (Appendix I) further analyzed skills in order to facilitate use of common cues (Graham et al., 1998). Lesson plans were developed based upon the developmental task analysis of each skill and the developmental level of the participants. A panel of three motor development and/or physical education pedagogy experts evaluated lesson plans to ensure the quality of content and validity of progressions. All of the panel experts were either Ph.D. students, Ph.D. candidates, or had received a Ph.D. in the area of physical education pedagogy or motor development. All panel experts were teacher-certified, and had extensive training in both skill analysis and content analysis. These experts reviewed daily and weekly lesson plans for appropriateness of activities and skill progressions. When clarifications or modifications were suggested, lesson plans were revised and re-submitted for review. In line with the DST, only four lesson plans for each skill were developed prior to the intervention. The remaining lesson plans were developed throughout the intervention period based upon the emerging motor development needs of the participants (Goodway-Shiebler, 1994). Appendix J includes an illustration of a typical lesson plan, and Appendix I includes skill sequences. An accountability assessment for intervention integrity (Appendix K) is also provided.

The motor skill intervention was provided twice weekly for 45 minutes. Every class was lead by the same instructor (primary researcher), who facilitated a large group warm-up with music prior to OC instruction. Warm-up activities (such as pretending to
be a car and “driving” fast, slow, backward, sideways, etc.) were provided in order to prepare the participants for activity. Intervention participants were randomly assigned to one of three daily task stations (catch, overhand throw, strike, dribble, underhand roll, or kick) for a period of 10 minutes. Three skills were randomly assigned to weeks, with at least 2 consecutive sessions. It was assured that each of the six skills was provided for 80-minutes of instructional time (see Table 3.3). Within each skill station, children were instructed via skill progressions of 3 instructional activities that were adapted from Graham et al. (1998), Kirchner and Fishburne (1998), PE Central (2001), and the primary researcher’s original ideas. To illustrate, an example of a throwing skill station might be guided by the goal of hitting a target of various colored spots which are painted on a bed-sheet. As the children enter the station, the station facilitator would remind the children of the goal, provide a demonstration, and state the cues of the task while demonstrating. For the first progression, children would then be instructed to throw a pretend ball at the target. Children would practice the throwing motion as the facilitator cued performance of individual children. The second progression might be to choose a ball (from various sized and weighted balls) and try to hit one of the colored spots on the target. The facilitator would continue to cue and provide corrective feedback to individual children, as well as individualize instruction by encouraging children to move closer or further from the target in order to meet the station goal. The third progression might include a challenge for students to hit as many of the different spots on the target as possible. Again, students would be encouraged to individually modify the task (moving further from or closer to the target, ball choice) in order to achieve success. In this manner, the intervention was individually tailored to meet the developmental needs of each child.
Once children were in stations, the role of the primary researcher was to monitor the session for instructional as well as managerial concerns. The intervention group was taught the mature elements of form, but given their age, mastery of all elements of form were not expected (Seefeldt & Haubensstricker, 1982).

**Training of Instructional Assistants**

One or two undergraduate motor development students fulfilling a 10-hour service learning requirement for a Lifespan Motor Development (LMD) class, supervised by the primary researcher, acted as facilitators at stations. Students enrolled in LMD are typically junior or senior-level Physical Education majors in the degree of Sport and Leisure Studies. Students enrolled in LMD were given a choice between service-learning environments of an early-childhood setting (this intervention) or an older-adulthood setting. Prior to the intervention, all of the undergraduate students received limited training in the area of motor development including topics such as principles of motor development, stages of fundamental motor skills and feedback (Gabbard, 2000; Haywood & Getchell 2001; Payne & Isaacs, 2002). Students were trained to identify stages of skill development (including the OC skills provided in this intervention) and to provide corresponding cues for performance. Regarding accuracy of cue feedback, student facilitators for this intervention were required to receive a minimum score of 85% accuracy on stage identification and respective cue responses. Student assistants fulfilled this requirement by coding children’s stages from videotape viewed during LMD class sessions prior to the intervention period. Two opportunities were provided in order for students to meet the criterion score. Students not meeting the criterion during the first opportunity were provided extra practice and assistance. The primary researcher
furnished practice videotapes, and was available for consultation. All facilitators for this intervention met criterion prior to intervention. Additionally, the primary researcher required each undergraduate student expressing interest in facilitating activities for this intervention to complete at least two hours of site observation, and two microteaching episodes using the instructor’s lesson plans.

The primary investigator provided the facilitators with daily lesson plans (Appendix J) for each station, and discussed the lesson plan for the day including key elements of instruction such as cues and progressions (see Appendix K). Facilitators were randomly assigned to stations so as not to influence the participant’s activities. At the end of each lesson the primary researcher reviewed the activities with the facilitators and made instructional decisions for the next lesson based upon feedback from that lesson. As the primary researcher monitored activity in the three stations provided each day, she noted the progress of the participants during their activities. If, despite the task analysis progressions, the planned activities appeared to be too advanced or remedial for the participants, activities for the following lessons were adjusted accordingly. Additionally, anecdotal notes regarding the session activities and participation patterns of participants were recorded by the primary researcher on the daily lesson plans. Instrumental in the instructional decision-making process was feedback provided by intervention integrity worksheets, which are described in greater detail in a following section.

Lesson Implementation

Intervention group participants were randomly assigned to one of three daily task stations (catch, overhand throw, strike, dribble, underhand roll, or kick) for a period of 10 minutes. A typical method of assignment was that children were given scarves for a
warm-up activity. Children with pink scarves would move to station 1, yellow scarves to station 2, and orange scarves to station 3. Within each station, children were instructed via skill progressions of 3 instructional activities. Allotment of instructional time per skill can be seen in Table 3.3.

The primary researcher provided clear directions for each station and demonstrated each activity to the whole group of children. Consistent key words were used by the primary researcher, and were re-emphasized by station facilitators in order to assist the children in remembering the critical elements of each task (Appendix I). Once children were assigned to task stations, facilitators within stations reinforced these key words throughout the activities, along with giving positive-specific and corrective feedback. The primary researcher rotated through the gym in order to monitor activities within stations. Within stations, activities were individualized to challenge all children at their own skill level, and each child was provided her or his own equipment. Following each 10-minute period, the primary researcher announced, “Freeze, clean up your equipment, point to your next station, and rotate,” in order for the children to change stations.

**Intervention Integrity**

Intervention integrity ensures that an intervention meets specific process criteria in order to reach the intervention goals and objectives. For this study, intervention integrity assessed during lessons provided immediate feedback regarding lessons and stations. The immediacy of this feedback allowed lesson and/or activity adjustment in order to increase the probability that goals and objectives would be met. Because facilitators were providing instruction within stations, intervention integrity assured
quality of instruction. During the eight-week intervention, a trained research assistant collected integrity information within stations concurrent with lesson implementation. This research assistant was a Ph.D. candidate in Sport and Exercise Education. She was teacher-certified, and had prior experience and training in supervisory instrumentation. Information was recorded regarding consistency of instruction, demonstration, feedback, equipment, and time within stations. Integrity data was collected via an intervention integrity worksheet (Appendix K) and following a fading schedule. This integrity data was collected at every station and every lesson during the first week of intervention, with a 100% integrity accuracy rating (Table 3.4). During week two, data was collected every lesson at only two of the stations, evidencing a 100% intervention accuracy rating.

During week three of the intervention, data was collected every other lesson, but at every station. Accuracy was 96% for week three. For the remaining five weeks, intervention integrity data was collected during four random sessions and at four random stations. The resulting accuracy for week four (100%), five (96%), six (100%), seven (not assessed), and eight (96%) did not fall below 96% (Table 3.4).

The primary researcher reviewed intervention integrity worksheets immediately following assessment in order to confirm at least 90% station and lesson accountability. If a station or lesson were to have fallen below criterion, the primary investigator would have engaged the station facilitators in review and re-teaching of station and lesson intervention protocol. In this case, the fading schedule would have also reverted to the observation schedule of the previous week. Due to the accuracy ratings of this intervention, retraining and reverting were not necessary.
<table>
<thead>
<tr>
<th>WEEK</th>
<th>SESSION</th>
<th>STATIONS (Name)</th>
<th>ACCURACY SCORE (lesson percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Kick, Throw, Roll</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Kick, Throw, Roll</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Strike, Catch</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Dribble, Catch</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>Catch, Kick, Throw</td>
<td>96%</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>Strike, Dribble</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>Roll</td>
<td>96%</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>Strike, Dribble</td>
<td>100%</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>Strike, Throw</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Mean</strong></td>
<td><strong>99%</strong></td>
</tr>
</tbody>
</table>

Note: Seven of eight weeks were assessed; nine of sixteen sessions were assessed; each skill was assessed at least three times.

Table 3.4: Intervention Integrity Accuracy Data
Comparison Condition

The comparison groups participated in their typical school routine without receiving an object-control skill intervention. Students in the comparison group participated in a 30-minute PE class once a week, which was provided by a certified physical education teacher. The focus of the PE class was fitness and muscular development. Students freely moved among stations such as stair-stepping, sit-ups, pull-ups, rope-jumping, balance-beam, and locomotor activities. Few, if any, object control activities were taught during the intervention period. Participants were also provided a 30-minute recess following lunch.

Rationale for Selection of Statistical Procedures

Random assignment of participants to groups was not possible in this study due to the organizational structure of the school environment. Intact groups are often analyzed using non-parametric techniques because non-parametric statistics make fewer assumptions pertaining to population parameters (Hopkins, Hopkins, & Glass, 1996) such as distribution. Normal distribution is a critical concept in the use of parametric statistics, and it is often assumed that unless groups are randomly assigned, normal distribution will not be evidenced (Hopkins et al., 1996). This was not the case, however, in the data set for this research. Descriptive statistics and data plots for the variables in this study evidenced uni-modal, symmetrical patterns of data that were statistically similar in variance and normally distributed (Figure 3.1). The use of parametric statistics also assumes independence of intervention effects.
The unit of analysis in this study was considered to be the student, as individual effects of the intervention are supported by the DST. Additionally, individualization of instruction provided within skill stations for the intervention participants also resulted in independence of effects.

Recent intervention studies involving intact groups (Hamilton et al., 1999; Wilkinson, Hillier, Padfield, & Harrison, 1999) have employed parametric rather than non-parametric statistics when analyzing data that is at least at the interval level of measurement. Additionally, from a dynamic systems perspective, each child within a classroom is unique. Each child, therefore, impacts and is impacted by a situation differently. From a dynamical systems perspective, analyzing individual children as a single group discounts many of these differences, which may ultimately help explain performance. For these reasons, parametric statistics were utilized in order to answer research questions 1, 2, 4, and 5 for this study.
Note: Matrix scatter plot for each of the variables in the data set illustrates that the groups are normally distributed and have similar variance.

Figure 3.1: Data Matrix Plot
Data Analysis

This study will focus on research questions in six areas (Table 3.5). Specific research questions, hypotheses, and statistical procedures follow.

Research Question 1

What are the pre-intervention object control skill levels and perceived physical competence of participants?

Hypothesis 1

a) All groups of participants will evidence delay (below the 25th percentile) in object control (OC) skills at pre-intervention.

b) There will not be significant differences between intervention and comparison groups on measures of OC skills at pre-intervention.

c) There will not be differences between groups on measures of perceived physical competence (PPC) at pre-intervention.

Research Question 2

Are there gender differences in pre-intervention OC skills and/or PPC of participants?

Hypothesis 2

a) Prior to the intervention, male participants will demonstrate higher levels of OC skills as compared to female participants.

b) Male participants will demonstrate higher levels of PPC than female participants, prior to the intervention.
Statistical Procedures for Hypothesis 1 and 2

A multivariate analysis of variance (MANOVA) was used to test the first and the second hypotheses. This analysis examined the two groups (intervention or comparison) regarding initial results on pre-intervention measures of OC scores and PPC scores. A MANOVA is a statistical procedure used to assess differences between one or more than one categorical variable (group, gender) on more than one metric dependent variable (Hair, Anderson, Tatham, & Black, 1998), which in this case were pre-intervention OC scores and pre-intervention PPC scores. Post-hoc analyses for significant MANOVA results were computed with a paired sample t-test. The t-test examined the two groups (intervention or comparison) regarding significant results on pre-intervention measures of OC scores and PPC scores from the MANOVA. The paired sample t-test evaluates whether the mean of the difference between the variables is significantly different from zero (Green, Salkind, & Akey, 2000). Because conducting multiple t-tests raises the probability of a Type I error, Bonferroni adjustment was used (Hair et al., 1998). The Bonferroni adjustment is achieved by dividing the single test alpha by the number of tests to be performed (Hair et al., 1998). In this study, the adjusted alpha level was set at .05 (alpha = .05 divided by number of comparisons = 4) for determining group differences on pre-intervention scores.
Research Question 3

What are the predictors of object control performance prior to the intervention period?

Hypothesis 3

It is hypothesized that gender, age, risk factors, pre-intervention PPC, body mass index (BMI), and grip strength will explain a moderate (.30-.49; Davis, 1971) percent of the variance in pre-intervention OC skill performance for participants.

Statistical Procedure for Hypothesis 3

For the third hypothesis, a Backward elimination multiple regression was utilized in order to identify the possible predictors of pre-intervention OC score for each group. The Backwards Stepwise Regression method computes a regression equation with all of the independent variables entered in the first block, and then deletes variables that do not significantly contribute to the equation (Hair et al., 1998). Variables are then ranked in the order of importance regarding that equation. The variables entered in their predicted order of importance were gender, age, risk factors, pre-intervention PPC, BMI, and grip strength.

Research Question 4

Do OC skills and/or PPC improve as a result of participation in an eight-week object control motor skill intervention?
Hypothesis 4

a) The intervention group will have statistically significant pre-intervention to post-intervention improvement in OC skills as compared to the comparison group, who will not show significant improvement across the intervention period.

b) Neither the intervention nor the comparison group will exhibit significant pre-intervention to post-intervention improvement in PPC.

c) The intervention group will have significantly higher post-intervention OC skill levels as related to the comparison group.

Research Question 5

What is the influence of gender on OC skills and PPC as a result of an eight-week object control motor skill intervention?

Hypothesis 5

a) There will not be a significant gender effect for OC skills from pre-intervention to post-intervention for the intervention group.

b) There will not be a significant gender effect for PPC from pre-intervention to post-intervention for the intervention group.

c) Gender differences on post-intervention OC skills within the intervention group (female, male) are not expected at post-intervention.

Statistical Procedures for Hypothesis 4 and 5

A MANOVA with repeated measures was used to test hypothesis 4 and hypothesis 5. A MANOVA is a statistical procedure used to assess differences between one or more than one categorical variable (group, gender) on more than one metric dependent variable (Hair, Anderson, Tatham, & Black, 1998). This analysis considered the group effect,
gender effect, the time effect (pre-to-post-intervention), and the interactions among these variables relative to OC scores and PPC scores. Hypothesis 4a) was tested via the Group X Time interaction for OC scores, and 4b) was tested via the Group X Time interaction of PPC scores. Hypothesis 5a) was tested via the Group X Time X Gender interaction for OC scores. Hypothesis 5b) was tested via the Group X Time X Gender interaction for PPC scores. Hypotheses 4c) was tested by an ANOVA considering the Group effects on post-intervention OC scores, and hypothesis 5c) was tested by the Group X Gender effect on post-intervention OC scores for the intervention group. Post-hoc analyses for significant MANOVA results were computed with a paired sample t-test and corresponding Bonferroni adjustment (alpha = .05 divided by number of comparisons = 4). Post-hoc analyses for significant ANOVA results were computed via an independent sample t-test, which evaluated whether means for two independent groups were significantly different from each other (Green et al., 2000). The Bonferroni adjustment (alpha = .05 divided by number of comparisons = 2) was also used for the independent sample t-tests (Hair et al., 1998).

Research Question 6

What are the predictors of OC skills for each group following intervention?

Hypothesis 6

a) It is hypothesized that for the intervention group, pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, BMI, grip strength, and pre-intervention PPC score will explain a substantial (.50-.69; Davis, 1971) percent of the variance in object control skill scores following the intervention period.
b) It is hypothesized that the variance in post-intervention OC skills for the comparison group will be moderately (.30-.49; Davis, 1971) predicted by the variables of pre-intervention OC scores, gender, age, risk factors, post-intervention PPC, pre-intervention PPC, body mass index (BMI), and grip strength.

*Statistical Procedures for Hypothesis 6*

For the last hypothesis, a backward elimination multiple regression was utilized in order to identify the possible predictors of post-intervention OC score for each group. For hypothesis 6a), the variables entered in their predicted order of importance for the intervention group were pre-intervention OC score, gender, age, risk factors, post-intervention PPC, BMI, grip strength, and pre-intervention PPC. For hypothesis 6b), the variables entered in their predicted order of importance for the comparison group were pre-intervention OC scores, gender, age, risk factors, post-intervention PPC, pre-intervention PPC, body mass index (BMI), and grip strength. A summary of the research questions along with statistical procedures can be found in Table 3.5.
<table>
<thead>
<tr>
<th>Research Question</th>
<th>DV</th>
<th>IV</th>
<th>Method of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the pre-intervention developmental level of participants for OC* and PPC***?</td>
<td>Pre OC, Pre PPC</td>
<td>Group (I, C)</td>
<td>a) Descriptive statistics</td>
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<tr>
<td></td>
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<td></td>
<td>b) MANOVA (for main effect of group): Group X Gender X Score for OC, Post-hoc paired sample t-test, Bonferroni adjustment</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>c) MANOVA (for main effect of group): Group X Gender X Score for PPC, Post-hoc paired sample t-test, Bonferroni adjustment</td>
</tr>
<tr>
<td>2. Are there gender differences in the pre-intervention level (OC, PPC) of participants?</td>
<td>Pre OC, Pre PPC</td>
<td>Gender (F, M), Group (I, C)</td>
<td>a) MANOVA (for main effect of gender): Group X Group X Score for OC, Post-hoc paired sample t-tests, Bonferroni adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b) MANOVA (for main effect of gender): Group X Group X Score for PPC, Post-hoc paired sample t-tests, Bonferroni adjustment</td>
</tr>
<tr>
<td>3. What are the predictors of object control performance prior to intervention?</td>
<td>Pre OC</td>
<td>Gender; Age; Risk Factors; PPC; BMI; Grip Strength</td>
<td>Backwards Stepwise Multiple Regression</td>
</tr>
<tr>
<td>4. Do participants benefit from receiving an 8-week object control intervention?</td>
<td>Pre Scores for OC, PPC; Post Scores for OC, PPC</td>
<td>Group (I, C), Gender (M, F)</td>
<td>MANOVA with repeated measures (for group X time interaction): Group X Gender X Pre-to-Post OC Score and PPC Score a) Group X Time for OC b) Group X Time for PPC c) Group effect on Post-OC Score (ANOVA) Post-hoc t-tests, Bonferroni adjustment</td>
</tr>
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Table 3.5: Data Analysis Chart
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<th>Research Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. What is the influence of gender on OC skills and PPC as a result of an eight-week object control motor skill intervention?</td>
</tr>
<tr>
<td>a) Do males have more OC improvement over time?</td>
</tr>
<tr>
<td>b) Do males have more PPC improvement over time?</td>
</tr>
<tr>
<td>c) Do males have higher Post-OC scores than females?</td>
</tr>
<tr>
<td>DV</td>
</tr>
<tr>
<td>Pre Scores for OC, PPC; Post Scores for OC, PPC</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
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<tr>
<td>6. What are the predictors of object control performance following intervention?</td>
</tr>
<tr>
<td>a) I group</td>
</tr>
<tr>
<td>b) C group)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Note: *OC = raw score of object control subscale of TGMD-2  
**PPC = perceived physical competence subscale of PAPCSA
CHAPTER 4

RESULTS

Chapter four focuses upon the results of the study. Results are presented relative to each research question and corresponding hypothesis. A chapter summary follows.

Research Question 1

What are the pre-intervention object control skills and perceived physical competence of participants?

Hypothesis 1

a) All groups of participants will evidence delay (below the 25th percentile) in object control (OC) skills at pre-intervention.

b) There will not be significant differences between intervention and comparison groups on measures of OC skills at pre-intervention.

c) There will not be differences between groups on measures of perceived physical competence (PPC) at pre-intervention.
Research Question 2

Are there gender differences in pre-intervention OC skills and/or PPC for participants?

Hypothesis 2

a) Prior to intervention, male participants will demonstrate higher levels of OC measures as compared to female participants.

b) Male participants will demonstrate higher PPC measures than female participants, prior to intervention.

Results for Research Questions 1 and 2

Descriptive statistics for hypothesis 1a) demonstrated mean object control (OC) pre-intervention raw scores for the intervention group as slightly lower than those of the comparison group (Table 4.1). Additionally, both groups were considered below average on their object control skills (Ulrich, 2000). When percentile ranks were computed, the intervention group evidenced a lower (9.11%) rank than did the comparison group (13.12%). Both groups were below the 25th percentile and thus were considered developmentally delayed (Ulrich, 2000). Additionally, Table 4.2 illustrates the individual skill mean scores for groups and genders regarding pre-intervention and post-intervention OC skills. These individual mean scores reflect the scores making up the OC raw score.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Group</th>
<th>Pre-intervention M</th>
<th>Pre-intervention SD</th>
<th>Post-intervention M</th>
<th>Post-intervention SD</th>
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</thead>
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<td>11.75</td>
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<td>2.86</td>
<td>20.38</td>
<td>2.77</td>
</tr>
<tr>
<td>Competence Total</td>
<td>C</td>
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<td>2.54</td>
<td>21.04</td>
<td>2.69</td>
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<td>0.48</td>
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<td>0.46</td>
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<td>Competence Profile</td>
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<td>(1-4)</td>
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Note: I = Intervention Group, C = Comparison Group

Table 4.1: Pre-intervention to Post-intervention Scores by Group
<table>
<thead>
<tr>
<th>SKILL</th>
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<th>Post-intervention</th>
<th>Post-intervention</th>
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<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
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<td>Kick</td>
<td>I</td>
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<td>5.86</td>
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<td>(0-8)</td>
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<td>1.27</td>
<td>4.53</td>
<td>1.20</td>
</tr>
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<td>1.33</td>
<td>5.87</td>
<td>0.95</td>
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<td></td>
<td>IM</td>
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<td>1.11</td>
<td>5.85</td>
<td>1.77</td>
</tr>
<tr>
<td></td>
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<td>4.05</td>
<td>0.80</td>
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<td>1.45</td>
<td>4.92</td>
<td>1.32</td>
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<td>6.89</td>
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<td>2.39</td>
<td>4.69</td>
<td>2.75</td>
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</tbody>
</table>

Note: I = Intervention group, C = Comparison Group, F = Female, M = Male

Table 4.2: Pre-intervention to Post-intervention OC Skill Scores by Group and Gender
A multivariate analysis of variance (MANOVA) was used to test hypotheses 1b), 1c), 2a), and 2b). Table 4.3 shows the mean scores for the OC and PPC measures. Table 4.4 shows the MANOVA table for OC and PPC. The MANOVA analysis examined the two groups (intervention or comparison) and the two genders regarding results on pre-intervention OC raw scores and PPC total scores (Table 4.4). A main effect for group shows the results for hypothesis 1b) regarding OC skills \(F[1, 89] = .53, p = .47, \eta^2 = .01\) and results for hypothesis 1c) regarding PPC scores \(F[1, 89] = 3.26, p = .07, \eta^2 = .04\). These analyses determined that there were no group mean differences on pre-intervention measures of OC skills and PPC scores. Because statistically significant differences were not found, no post-hoc analyses were computed for hypotheses 1b) and 1c).

For hypothesis 2a) concerning gender, the MANOVA analysis indicated a main effect for gender in pre-intervention OC scores \(F[1, 89] = 19.10, p < 0.00, \eta^2 = .18\). As predicted, males \((M = 19.75, SD = 7.01)\) demonstrated higher OC raw scores than did females \((M = 13.77, SD = 5.21)\). Post-hoc paired samples t-tests confirmed this mean difference \((t[89] = -4.64, p = .00 [2-tailed])\). No statistically significant gender effects for pre-intervention PPC total scores were found, as were predicted in hypothesis 2b). Male participants \((M = 20.02, SD = 2.75)\) and female participants \((M = 20.35, SD = 2.70)\) were statistically similar regarding PPC total scores at pre-intervention, and therefore, no post-hoc analyses were computed (Table 4.4).
<table>
<thead>
<tr>
<th>Measure</th>
<th>Group</th>
<th>Gender</th>
<th>Pre-intervention</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
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<td>I</td>
<td>F</td>
<td>14.19</td>
<td>5.80</td>
<td>28.50</td>
<td>7.92</td>
</tr>
<tr>
<td>Raw (0-48)</td>
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<td>M</td>
<td>18.00</td>
<td>6.40</td>
<td>33.46</td>
<td>9.07</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>F</td>
<td>13.24</td>
<td>4.45</td>
<td>18.05</td>
<td>5.51</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>M</td>
<td>20.57</td>
<td>7.28</td>
<td>25.67</td>
<td>8.49</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>F</td>
<td>13.77</td>
<td>5.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>M</td>
<td>19.75</td>
<td>7.01</td>
<td></td>
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</tr>
<tr>
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<td>F</td>
<td>7.23</td>
<td>8.94</td>
<td>50.38</td>
<td>29.56</td>
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<td>M</td>
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<td>59.15</td>
<td>31.02</td>
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<td>16.62</td>
<td>17.93</td>
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<td>17.71</td>
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<td>16.81</td>
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<td>20.03</td>
<td>2.81</td>
<td>21.92</td>
<td>2.25</td>
</tr>
<tr>
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<td>M</td>
<td>19.24</td>
<td>2.95</td>
<td>18.86</td>
<td>3.09</td>
</tr>
<tr>
<td></td>
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<td>F</td>
<td>20.77</td>
<td>2.56</td>
<td>21.15</td>
<td>3.18</td>
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<tr>
<td></td>
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<td>M</td>
<td>20.50</td>
<td>2.56</td>
<td>20.96</td>
<td>2.35</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>F</td>
<td>20.35</td>
<td>2.70</td>
<td></td>
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<tr>
<td></td>
<td>B</td>
<td>M</td>
<td>20.02</td>
<td>2.75</td>
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<td>F</td>
<td>3.34</td>
<td>0.47</td>
<td>3.53</td>
<td>0.37</td>
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<td>Competence Profile (1-4)</td>
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<td>F</td>
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<td>3.53</td>
<td>0.52</td>
</tr>
<tr>
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<td>C</td>
<td>M</td>
<td>3.42</td>
<td>0.43</td>
<td>3.49</td>
<td>0.39</td>
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<td></td>
<td>B</td>
<td>F</td>
<td>3.92</td>
<td>0.45</td>
<td></td>
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<tr>
<td></td>
<td>B</td>
<td>M</td>
<td>3.37</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: I = Intervention Group, C = Comparison Group, B = Both Groups; F = Females, M = Males

Table 4.3: Pre-intervention and Post-intervention Scores by Group and Gender
<table>
<thead>
<tr>
<th>Variable</th>
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<th>p</th>
<th>( \eta^2 )</th>
</tr>
</thead>
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<td></td>
</tr>
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<td>Group</td>
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<td>.01</td>
</tr>
<tr>
<td>Gender</td>
<td>19.10</td>
<td>.000</td>
<td>.18</td>
</tr>
<tr>
<td>Group X Gender</td>
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<td>.15</td>
<td>.02</td>
</tr>
<tr>
<td><em>Post-hoc t-test on OC for Group ((t [89] = -4.64, p = .00 \text{ [2-tailed]}))</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perceived Physical Competence</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
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<td>.04</td>
</tr>
<tr>
<td>Gender</td>
<td>0.80</td>
<td>.38</td>
<td>.01</td>
</tr>
<tr>
<td>Group X Gender</td>
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<td>.61</td>
<td>.00</td>
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</tbody>
</table>

*Note: degrees of freedom = 1, 89. Only one post-hoc t-test was computed, as significance was found only in pre-intervention OC scores by group.*

Table 4.4: MANOVA and Post-Hoc Paired t-test Regarding Pre-intervention Object Control Scores and Perceived Physical Competence Scores

Research Question 3

What are the predictors of object control performance prior to the intervention?

**Hypothesis 3**

It is hypothesized that gender, age, risk factors, pre-intervention PPC, body mass index (BMI), and grip strength will explain a moderate (.30-.49; Davis, 1971) percent of the variance in pre-intervention OC skill performance for the intervention and comparison groups.

**Results for Research Question 3**

A backward elimination multiple regression was performed on the pre-intervention variables in order to predict the pre-intervention OC score: gender, age, risk factors, pre-intervention PPC, BMI, and grip strength. Initial correlations indicated that
the variables gender (.40), grip strength (.37), pre-intervention PPC (.34), and age (.26) were most related to the pre-intervention OC score (Table 4.5). Beginning with a model containing all of these variables, a backwards regression was utilized to obtain a final reduced model accounting for 41% of the variance in pre-intervention OC scores (Table 4.6). On step two, the variable of risk factors was removed, resulting in the variables of grip strength, gender, pre-intervention PPC score, age, and BMI explaining 40% of the variance in pre-intervention OC scores. On step three, the variable of BMI was removed, resulting in the variables of grip strength, gender, pre-intervention PPC score, and age explaining 39% of the variance in pre-intervention OC scores. In the final step, grip strength was removed, resulting in the variables of gender, pre-intervention PPC, and age explaining 37% of the variance in pre-intervention OC scores (Table 4.6).
<table>
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<td>2.60</td>
<td>.34</td>
</tr>
<tr>
<td>BMI</td>
<td>9.46</td>
<td>1.62</td>
<td>-.03</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>8.70</td>
<td>3.16</td>
<td>.37</td>
</tr>
</tbody>
</table>

Table 4.5: Means, Standard Deviations, and Correlations for Predictor and Criterion Variables at Pre-Intervention

<table>
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<th>Model</th>
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<th>$R^2$</th>
<th>SE</th>
<th>Variables Removed</th>
</tr>
</thead>
<tbody>
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<td>.41</td>
<td>5.36</td>
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</tr>
<tr>
<td>2</td>
<td>.64</td>
<td>.40</td>
<td>5.36</td>
<td>risk factors</td>
</tr>
<tr>
<td>3</td>
<td>.62</td>
<td>.39</td>
<td>5.36</td>
<td>BMI</td>
</tr>
<tr>
<td>4</td>
<td>.61</td>
<td>.37</td>
<td>5.40</td>
<td>grip strength</td>
</tr>
</tbody>
</table>

Note: On step 1, the variables entered into the model are gender, age, risk factors, pre-intervention PPC, BMI, and grip strength.

Table 4.6: Predictors of Pre-intervention Object Control scores
Research Question 4

Do OC skills and/or PPC improve as a result of participation in an eight-week object control skill intervention?

Hypothesis 4

a) The intervention group will have statistically significant pre-intervention to post-intervention improvement in OC skills in contrast to the comparison group, who will not show significant improvement across the intervention period.

b) Neither the intervention nor the comparison group will exhibit significant pre-intervention to post-intervention improvement in PPC.

c) The intervention group will have significantly higher post-intervention OC skill levels as related to the comparison group.

Research Question 5

What is the influence of gender on OC skills and PPC as a result of an eight-week object control motor skill intervention?

Hypothesis 5

a) There will not be a significant gender effect for OC skills from pre-intervention to post-intervention for the intervention group.

b) There will not be a significant gender effect for PPC from pre-intervention to post-intervention for the intervention group.

c) Gender differences on post-intervention OC skills within the intervention group (female, male) are not expected at post-intervention.
Results for Research Questions 4 and 5

A MANOVA with repeated measures was used to test hypotheses 4a), 4b), 5a), and 5b). Results from the MANOVA for hypothesis 4a) indicated that there was a statistically significant Group X Time interaction ($F[1, 75] = 14.44, p < .00, \eta^2 = .16$). The means from Table 4.1 demonstrate that the intervention group improved in OC scores more than the comparison group from pre-intervention to post-intervention, which was confirmed with a post-hoc paired samples t-test ($t[35] = -13.97, p = .00$ [2-tailed]). Table 4.1 also shows the percentile ranks across the intervention period with the intervention group improving from the 9th to the 53rd percentile, and the comparison group from the 13th to the 25th percentile. Hypothesis 4b) posits that there will not be a significant Group X Time interaction for PPC scores. Table 4.1 illustrates that, over the intervention period, the intervention group went from PPC total scores of 19.74 to 20.38, whereas the comparison group went from 20.62 to 21.04. Although statistically significant ($F[1, 75] = 37.36, p < .00, \eta^2 = .33$), neither group evidenced much improvement in PPC scores over the intervention period. Additionally, post-hoc analysis did not detect significant difference between the intervention and comparison groups regarding PPC ($t[39] = -1.75, p = .09$ [2-tailed]). The MANOVA results for hypothesis 5a) demonstrated no significant effects for Group X Time X Gender ($F[1, 75] = .17, p = .69, \eta^2 = .00$) regarding OC scores. Table 4.3 shows that females in the intervention group improved their OC scores from 14.19 to 28.50, whereas females in the comparison group moved from 13.24 to 18.05. Regarding males, the intervention group improved from 18.00 to 33.46, whereas males in the comparison group went from 20.57 to 25.67. Hypothesis 5b) predicted that no significant gender effects would be evident for the
interaction of Group X Time X Gender for PPC scores. Results indicated that this interaction was not significant ($F[1, 75] = .00, p = .98, \eta^2 = .00$). Mean scores (Table 4.2) show that males in the intervention group actually had a slight decline in PPC total scores (from 19.24 to 18.86), while males in the comparison group moved from 20.50 to 20.96 during the intervention period. Females in the intervention group improved their PPC total scores from 20.03 to 21.92, while females in the comparison group moved from 20.77 to 21.15 during the intervention period. Table 4.7 shows OC and PPC MANOVA results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$F$</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1.97</td>
<td>.17</td>
<td>.03</td>
</tr>
<tr>
<td>Time X Gender</td>
<td>24.85</td>
<td>.00</td>
<td>.25</td>
</tr>
<tr>
<td>Time X Group</td>
<td>14.44</td>
<td>.00</td>
<td>.16</td>
</tr>
<tr>
<td>Group X Time X Gender</td>
<td>0.17</td>
<td>.69</td>
<td>.00</td>
</tr>
<tr>
<td><strong>Perceived Physical Competence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>195.07</td>
<td>.00</td>
<td>.72</td>
</tr>
<tr>
<td>Time X Gender</td>
<td>0.56</td>
<td>.46</td>
<td>.01</td>
</tr>
<tr>
<td>Time X Group</td>
<td>37.36</td>
<td>.00</td>
<td>.33</td>
</tr>
<tr>
<td>Group X Time X Gender</td>
<td>0.00</td>
<td>.98</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note: degrees of freedom = 1, 75

Table 4.7: MANOVA Regarding Pre-intervention to Post-intervention Object Control and Perceived Physical Competence Improvement
Post-intervention OC scores for hypotheses 4c) and 5c) were tested with an ANOVA. Results indicated a significant Group effect for post-intervention OC scores ($F[1, 75] = 25.97, p = .00, \eta^2 = .27$) as hypothesized in 4c). A statistically significant post-hoc independent samples t-test ($t[82] = 4.23, p = .00$ [2-tailed]) was also evidenced. Mean scores from Table 4.1 show the intervention group mean at 30.24, with the comparison group at 22.33 regarding post-intervention OC raw scores. The ANOVA indicated that there was not a statistically significant Group X Gender effect for post-OC scores ($F[1, 75] = .72, p = .40, \eta^2 = .01$), as hypothesized in 5c). Females in the comparison group scored approximately ten points lower (18.05 as compared to 28.50) than females in the intervention group, while males in the comparison group scored nearly eight points lower (25.67 as compared to 33.46) than did males in the intervention group (Table 4.2). ANOVA results can be seen in Table 4.8.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$F$</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>25.97</td>
<td>.00</td>
<td>.27</td>
</tr>
<tr>
<td>Gender</td>
<td>13.50</td>
<td>.00</td>
<td>.15</td>
</tr>
<tr>
<td>Group X Gender</td>
<td>0.72</td>
<td>.40</td>
<td>.01</td>
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</tbody>
</table>

Note: degrees of freedom = 1, 75

Table 4.8: ANOVA Regarding Post-intervention Object Control Scores
Research Question 6

What are the predictors of object control performance for each group following intervention?

Hypothesis 6

a) It is hypothesized that for the intervention group, pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, BMI, grip strength, and pre-intervention PPC score will explain a substantial (0.50-.69; Davis, 1971) percent of the variance in object control skill scores following the intervention period.

b) It is hypothesized that the variance in post-intervention OC scores for the comparison group will be moderately (0.30-.49; Davis, 1971) predicted by the variables of pre-intervention OC scores, gender, age, risk factors, post-intervention PPC, pre-intervention PPC, body mass index (BMI), and grip strength.

Results for Research Question 6

For hypothesis 6a), initial evaluation of the correlations for the intervention group indicated that the variables of pre-intervention OC score (0.67) and gender (0.31) were most related to post-intervention OC scores (Table 4.9). The initial backward elimination multiple regression model containing pre-intervention OC score, gender, age, risk factors, post-intervention PPC, BMI, grip strength, and pre-intervention PPC, accounted for 61% of the variance in post-intervention OC scores (Table 4.10). On step two, the variable of grip strength was removed, resulting in a model containing the variables of pre-intervention OC score, gender, age, risk factors, post-intervention PPC, BMI, and pre-intervention PPC score, and explaining 61% of the variance in post-intervention OC
score. On step three, the variable of age was removed, leaving the variables of pre-intervention OC score, gender, risk factors, post-intervention PPC, BMI, and pre-intervention PPC score, to explain 60% of the variance in post-intervention OC score. On the final step, the variable of risk factors was removed, leaving the variables of pre-intervention OC score, gender, post-intervention PPC, BMI, and pre-intervention PPC score, to explain 60% of the variance in post-intervention OC score (Table 4.10).
<table>
<thead>
<tr>
<th>Variable</th>
<th>$M$</th>
<th>$SD$</th>
<th>Correlation w/Post OC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predictor Variable</strong></td>
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</tr>
<tr>
<td>Post-intervention OC Score</td>
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<td></td>
</tr>
<tr>
<td><strong>Criterion Variables</strong></td>
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<tr>
<td>PreOC Score</td>
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<td>.60</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<td>Age (in months)</td>
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<tr>
<td>Risk Factors</td>
<td>1.88</td>
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<td>.01</td>
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<tr>
<td>Post PPC</td>
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<td>.06</td>
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<td>BMI</td>
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<td>-.30</td>
</tr>
<tr>
<td>Grip Strength</td>
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<td>.14</td>
</tr>
<tr>
<td>Pre PPC</td>
<td>19.24</td>
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<td>.09</td>
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Table 4.9: Post-Intervention Means, Standard Deviations, and Correlations for Predictor and Criterion Variables for Intervention Group

<table>
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<tr>
<th>Model</th>
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<td>2</td>
<td>.78</td>
<td>.61</td>
<td>6.05</td>
<td>grip strength</td>
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<tr>
<td>3</td>
<td>.77</td>
<td>.60</td>
<td>5.99</td>
<td>age</td>
</tr>
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<td>4</td>
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<td>.60</td>
<td>5.90</td>
<td>risk factors</td>
</tr>
</tbody>
</table>

Note: On step 1, the variables entered into the model are pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, BMI, grip strength, and pre-intervention PPC score.

Table 4.10: Predictors of Post-intervention Object Control Scores for the Intervention Group
For hypothesis 6b), initial evaluation of the correlation matrix for the intervention group indicated that the variables of pre-intervention OC score (.73), gender (.50), and grip strength (.33) were most related to post-intervention OC scores (Table 4.11). Because the comparison group did not receive the OC intervention, regression model for the comparison group was the same at post-intervention as it was for pre-intervention, with the addition of pre-intervention OC scores and post-intervention PPC scores. On step 1 of the regression, a model containing pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, pre-intervention PPC score, BMI, and grip strength accounted for 57% of the variance in pre-intervention OC scores (Table 4.12). Interestingly, after an eight-step model, only one variable was significantly predictive of post-intervention OC score for the comparison group. The variable of pre-intervention OC score accounted for 53% of the variance in post-intervention OC scores (Table 4.12).
<table>
<thead>
<tr>
<th>Variable</th>
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<td>Post-intervention OC Score</td>
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<td><strong>Predictor Variables</strong></td>
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</tr>
<tr>
<td>PreOC Score</td>
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<td>6.87</td>
<td>0.73</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>Age (in months)</td>
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<td>0.21</td>
</tr>
<tr>
<td>Risk Factors</td>
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<td>2.06</td>
<td>-0.14</td>
</tr>
<tr>
<td>Post PPC</td>
<td>21.07</td>
<td>2.64</td>
<td>0.08</td>
</tr>
<tr>
<td>Pre PPC</td>
<td>20.30</td>
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<td>BMI</td>
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<td>1.10</td>
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<td>Grip Strength</td>
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Table 4.11: Post-Intervention Means, Standard Deviations, and Correlations for Predictor and Criterion Variables for Comparison Group

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</tr>
</thead>
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<td>5.99</td>
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<tr>
<td>2</td>
<td>.75</td>
<td>.57</td>
<td>5.90</td>
<td>risk factors</td>
</tr>
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<td>.75</td>
<td>.57</td>
<td>5.75</td>
<td>Post-PPC</td>
</tr>
<tr>
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<td>.75</td>
<td>.56</td>
<td>5.69</td>
<td>BMI</td>
</tr>
<tr>
<td>6</td>
<td>.75</td>
<td>.56</td>
<td>5.64</td>
<td>grip</td>
</tr>
<tr>
<td>7</td>
<td>.75</td>
<td>.56</td>
<td>5.60</td>
<td>age</td>
</tr>
<tr>
<td>8</td>
<td>.73</td>
<td>.53</td>
<td>5.67</td>
<td>gender</td>
</tr>
</tbody>
</table>

Note: On step 1, the variables entered into the model are pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, pre-intervention PPC score, BMI, and grip strength.

Table 4.12: Predictors of Post-intervention Object Control Scores for the Comparison Group
CHAPTER 5

DISCUSSION/IMPLICATIONS/RECOMMENDATIONS

Physical activity interventions are important, as physical activity can be an effective deterrent of many chronic diseases (USDHHS, 1996). Additionally, involvement in various types of physical activity programs can be beneficial for skill development, health benefits, and healthy lifestyle choices (Seefeldt & Ewing, 1997). Organized movement experiences are beneficial to young children, as indicated in national physical activity guidelines for children birth through age 5, and the earlier the instruction is introduced, the greater the gains (NASPE, 2002). Development of proficient fundamental motor skills depends upon movement experiences, most notably early childhood movement experiences (Ulrich & Ulrich, 1993). Children who are not provided with quality physical programs may experience failure and frustration in movement activities. Such negative consequences may contribute to an inactive lifestyle (Payne & Isaacs, 2002; Seefeldt, 1980).

In an effort to positively enhance object control (OC) skill development, the purpose of this study was to provide a motor skill intervention for young children growing up in poor, urban communities. The research objectives of the study were to determine: (a) baseline measures of OC skills and perceived physical competence (PPC) of the participants; (b) if gender differences in measures were present; (c) predictors of OC motor skill performance at pre-intervention; (d) the impact of an eight-week object
control motor skill intervention on OC skills and PPC of the participants; (e) the influence of gender on OC and PPC scores as a result of an eight-week object control motor skill intervention; and (f) predictors of OC motor skill scores following the intervention. This study was significant in that few studies have examined gender differences in OC motor skill development of preschool and kindergarten-aged children.

Discussion for Hypothesis 1

It was hypothesized that both intervention and comparison groups of participants would evidence developmental delays in the OC skills prior to the intervention period. Additionally, it was hypothesized that there would not be significant difference on measures of OC skills or PPC scores between intervention and comparison groups at pre-intervention.

Data gathered prior to the eight-week intervention indicated that the children in this study were below average in their OC skills (Table 4.1), with OC skills at or below the 13th percentile as compared to same-aged peers (Ulrich, 2000). This data was not surprising given that delays in fundamental motor skills have been found in similar populations of children (Connor-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Hamilton, Goodway, & Haubenstricker, 1999). To illustrate, Goodway and Rudisill (1997) found that preschool African-American children who were disadvantaged demonstrated OC skills at the 16th percentile (boys) and the 5th percentile (girls) prior to intervention. Additionally, Hamilton et al. (1999) found that preschool children who were at-risk for developmental delay and/or educational failure demonstrated object control skills below the 20th percentile prior to the intervention. These studies also suggested that motor skill delays may be due to the lack of environmental support in motor development.
for these children (Goodway & Rudisill, 1997; Hamilton et al., 1999). From a DST perspective, motor skill development is viewed as context and learner specific (Thelen & Ulrich, 1991) and that interactions among the subsystems of the learner, the task, and the environment will influence motor skill development (Newell, 1984; Newell & Corcos, 1993; Thelen & Ulrich, 1991).

Informal observations throughout the intervention support the notion that the initial motor development of these participants was constrained by their environment. Prior to the intervention, many of the participants did not know how to use the equipment provided or perform the skills included in the intervention. For instance, the children would stand facing the tee (rather than sideways) and “chop” at the ball while holding the bat incorrectly, rather than attempt to swing the bat sideways. When asked if they had ever played baseball, most of the responses were “no,” and additionally, many of the children did not know anyone who did play baseball. This lack of familiarity with OC skills was not isolated to the strike. The skill of underhand rolling (and underhand tossing to a partner) proved quite problematic for most of the children. When attempting the underhand pattern, most of the participants would inadvertently “sling” the ball to the side or in back of themselves. If the closest adult to the child was not looking, many participants would revert to the overhand throwing pattern. In fact, the only skill that some of the children had practiced prior to the intervention was throwing, although the majority of children exhibited an immature throwing pattern prior to the intervention. When asked about home activities, many of the children indicated that they were not allowed to play outside, and/or that they had limited or no access to specialized sport equipment (baseball, football, basketball, bat, etc.). Reports from teachers confirmed that
many of the children lived in unsafe neighborhoods for play and/or did not have a significant adult to play with. It is, therefore, possible that the influence of environmental risk factors contributed to the developmental delays in the performance of fundamental OC skills for these children. These results are of concern, as the preschool and kindergarten years are considered prime times to develop children’s fundamental motor skills (NASPE, 2002; Seefeldt, 1980). Additionally, children who are living in poverty, such as the participants of this study, may increasingly find themselves with motor skill deficiencies and physical activity disadvantages as compared with their peers (Goodway & Rudisill, 1996; Hamilton et al., 1999).

Although their OC skills were lacking, the children in this study evidenced positive perceptions regarding their physical competence, with pre-intervention PPC composite means ranging between 3.29 and 3.44 for the intervention and comparison groups, respectively. This finding was also expected, based upon the literature in this area (Berk, 2000; Fox, 1997; Goodway & Rudisill, 1997; Harter, 1988; Harter & Pike, 1984). Harter and Pike (1984) reported PPC subscale composite means (range from 1-4) for preschool and kindergarten children between 3.2 and 3.4, respectively. Goodway & Rudisill (1997) reported pre-intervention PPC composite means at 3.21 and 3.35 for intervention and comparison groups of preschool children who were disadvantaged. Harter and Pike (1984) attribute young children’s high-perceived physical competence upon the age-related phenomenon that young children’s fantasies about the ideal self often shape beliefs of the real self. According to Piaget (1962) children between the ages of 2 and 6 are typically in the preoperations stage of cognitive development. Preoperational thinking tends to be centered around oneself. In preoperations, children
typically think well of themselves and do not make social comparisons, which would include comparing one’s dribbling performance with that of another (Piaget, 1962). Children in the preoperational stage of development are not yet able to conserve, and so are not able to consider multiple sources of information in a problem-solving situation. Therefore, children in preoperations are not capable of accurate perceptions involving perceived competence, as these children tend to focus only upon one aspect of a given situation. Perceived physical competence scores for young children are likely, therefore, to be somewhat inflated (Goodway & Rudisill, 1997; Harter & Pike, 1984). As children age and/or acquire more activity experience and a greater ability to problem-solve, these perceptions often shift gradually to become more realistic and match children’s actual performance (Berk, 2000; Fox, 1997; Goodway & Rudisill, 1997; Harter & Pike, 1984; Piaget, 1955). In this study, children had similar PPC scores to those reported by Harter and Pike (1984). Although perhaps inflated, studies that have investigated the role of perceived competence in motor performance and/or physical activity (Goodway & Rudisill, 1996; Rudisill, 1989; Theeboom et al., 1995; Weiss, Bredemeier, & Shewchuck, 1986) have confirmed the relationship between PPC and motivated activity behavior.

Prior to the intervention, groups (intervention, comparison) were not statistically different regarding either OC or PPC scores. This finding supports the initial similarity of these groups, and the suitability of these groups as comparisons. Perhaps these similarities were due, in part, to the fact that the schools were within the same district, used the same curriculum guidelines, and the compensatory preschool programs had identical selection criteria. Additionally, the schools were similar in demographics and educational need (AAA status).
Implications for Hypothesis 1

These findings raise interesting issues for young children who are growing up in poverty and attending urban elementary schools. The finding that the participants were at the 13th percentile in OC skill performance prior to the intervention period is of concern, as skill deficits in childhood tend to compound throughout the lifespan if intervention services are not provided (Payne & Isaacs, 2002; Seefeldt, 1980). Therefore, teachers and administrators need to become informed regarding early motor skill practices and recommendations such as those of Active Start (NASPE, 2002). Movement experiences for children should become a priority in preschools and elementary schools, and especially in urban environments where children tend to have exposure to many environmental risk factors.

The finding that the participants of this and other similar studies (Goodway, 1994; Goodway & Rudisill, 1997) evidenced high PPC scores raises hope that children who are living in poverty may not begin to develop negative perceptions of their physical abilities until after the preschool and kindergarten years. Motor skill intervention provided during these early years may, therefore, help sustain these positive perceptions throughout childhood.

Future Research Suggestions for Hypothesis 1

Because the participants of this study were delayed in their performance of OC skills prior to the intervention, future research should continue to investigate the efficacy of different types of developmentally appropriate OC interventions. Future research should examine the value of educating administrators and teachers about the benefits of motor skill intervention for young children.
For example, if educated about this literature as well as best practice, will administrators and teachers prioritize and implement motor skill programs for children in their classrooms?

Discussion for Hypothesis 2

The literature suggests that males typically outperform females on many fundamental motor skills (Halverson, et al., 1982; Haubenstricker et al., 1983; Seefeldt & Haubenstricker, 1982; Thomas & French, 1985). Thus, this study hypothesized that prior to the intervention, male participants would demonstrate higher scores on OC and PPC measures than female participants. In addition to being less physically skilled, especially regarding OC skills (Ulrich, 2000), national data reports that the prevalence of physical inactivity is higher among females than males (USDHHS, 1996). From a dynamical systems perspective, variables such as social role modeling and the environment may combine to influence the type and amount of activity in which a child engages. The research literature regarding gender in physical activity confirms that male children receive more parental support and encouragement for engaging in physical activity than do female children (Brustad, 1993; Eccles & Harold, 1991; Seefeldt & Ewing, 1997). This literature was consistent with the findings of the present study. Although both males and females in this study evidenced delays in OC skills, pre-intervention percentiles found males performing about twice as well as females, at 15.78% as compared to 6.92%, respectively.

Behavior patterns of the girls verses those of the boys during the early intervention sessions (sessions 1-6) suggested that perhaps girls had less prior experience in physical activity than the boys, accounting for the significant difference in OC scores.
At the beginning of the intervention, notes taken on lesson plans by the primary researcher reported that several of the girls were much more timid than the boys about engaging in the activities, as well as less forceful with their performance of the skills. These girls tended to stand by and watch many of the boys perform prior to performing themselves. Several of the boys, on the other hand, seemed visibly excited about performing, and had no problem with the instruction to "throw as hard as you can." Other anecdotal lesson plan reflections indicated that boys were more likely than girls to note that they had prior knowledge of and/or practice with some of the skills. When asked what they liked to do at home or during free time, girls tended to talk of sedentary play as opposed to boys, who often spoke of physical play.

Perceived competence can be thought of as the motivation to participate or continue in an activity based upon how an individual perceives his/her capability in that activity (Harter, 1978) and may influence persistence, motivation, effort, expectations, and ultimately, performance (Good, 1987; Martinek & Griffith, 1984; Weiner, 1985). Thus, PPC plays an important role in the way a child may interact or persist in a motor skill intervention. No gender differences were found in PPC at pre-intervention. These data contradict findings by Brustad (1993), who found that perceived physical competence was higher in boys than in girls, but is consistent with literature by Goodway and Rudisill (1997). Perhaps this difference was due in part to the fact that participants in the latter study were similar in ethnicity and poverty levels to the participants of this study, whereas participants in the former study were primarily Caucasian. The development of perceived competence is considered to be dependent upon four psychological constructs including past experiences, difficulty of challenge associated
with the task or performance, reinforcement and personal interactions with significant others regarding the task or the performance, and intrinsic motivation (Harter, 1978, 1982, 1988). Anecdotal evidence suggests the participants in this study had limited exposure to and/or experience in motor tasks, few had a significant other with whom to play, and all were between the ages of 4 and 6. It is most likely, therefore that the similarity between the PPC scores of boys and girls at pre-intervention was due to their similar environmental conditions and age-related cognitive stage of development (preoperations) and its characteristics.

Implications for Hypothesis 2

Girls perform OC skills significantly less well than boys. This finding has significant implications given the literature that girls engage in less physical activity than boys (Seefeldt & Ewing, 1997; USDHHS, 1996), and tend to receive less adult support for their physical performance (Brustad, 1993; Eccles & Harold, 1991; Taylor et al., 1999). Teachers and physical educators, therefore, have a major responsibility to ensure that the females in their classes receive appropriate instruction, incentive, and support for the development of motor skills.

Successful experiences impact not only actual skill level, but also perceptions of physical skill level. Because children who are growing up in poor, urban environments tend to have few opportunities to practice and master motor skills, they are more likely to experience failure more frequently than their peers (Ames, 1990, 1992; Berk, 2000; Goodway & Rudisill, 1996). Additionally, research has indicated that even by the first grade, girls assess their athletic ability more negatively than boys do in spite of their
objective equality in skill (Brustad, 1993). This, coupled with the fact that boys tend to receive more practice and encouragement for physical activity, compounds the need for teachers to ensure appropriate activities for females.

*Future Research for Hypothesis 2*

Future research should examine the efficacy of different kinds of motor skill interventions on the fundamental motor skill development of girls. Specifically, these interventions should seek to determine what types of pedagogical strategies work to enhance girls' motivation to engage in activity. Although the females in this study evidenced high PPC, longitudinal data has not been compiled indicating that early motor skill intervention is successful at sustaining these positive perceptions. Research to date has primarily focused on children older than preschool and kindergarten-aged. Longitudinal research involving preschool and kindergarten-aged children should, therefore, be conducted regarding the physical and psychological effects of motor skill intervention.

*Discussion for Hypothesis 3*

From a DST perspective movement develops from complex interactions among multiple subsystems (Kugler, Kelso, & Turvey, 1982; Magill, 1998; Newell, 1984; Thelen & Ulrich 1991). The challenge for the researcher is to identify those variables (subsystems) that account for OC skill development. It was hypothesized that gender, age, risk factors, pre-intervention PPC, BMI, and grip strength would explain a moderate percent of the variance in pre-intervention OC skill performance for the participants.
The variables entered into the regression model were ordered in sequence of predicted importance, based upon the research literature. The variable of gender has been well documented as a major contributor to physical performance. Males typically demonstrate better OC skills than do females (Ulrich, 2000). Males tend to be stronger and leaner due to hormonal makeup and related muscle mass (Nelson et al., 1991). Additionally, males tend to receive more physical practice at motor skills than do females (Taylor et al., 1999; Seefeldt & Ewing, 1997). Motor developmental literature supports the notion of age, in that as a child gets older, she/he typically becomes more skilled at physical tasks (Haywood & Getchell, 2002; Payne & Isaacs, 2002; Ulrich, 2000). Risk factors were included in the regression because research has indicated that these factors in a child’s life can have a devastating effect on overall development (Kazdin, 1995), which would include the development of motor skills. Typically, as the number of risk factors in a child’s life increases, the child’s development declines, as risk factors tend to be additive in nature (Kazdin, 1995). Because of the link between perceived and actual physical performance (Goodway & Rudisill, 1997; Harter, 1978; Weiss et al., 1986) pre-intervention PPC scores were thought to be important in predicting OC scores. The variable of BMI relates to the principle that a person will be more efficient with less non-power producing mass (fat) than with more non-power producing mass. Therefore, as BMI decreases, motor performance tends to increase (Malina & Bouchard, 1991). Finally, the variable of grip strength tends to be related to overall body strength (Baumgartner & Strong, 1994), and as such was thought to be related to the development of OC skills.
Prior to the intervention period, correlational patterns indicated that the predictor variables positively related to OC scores were: a) male gender, b) older age, c) low BMI score, d) high grip strength, and e) fewer risk factors. These patterns of prediction were consistent with the literature (Baumgartner & Strong, 1994; Goodway & Rudisill, 1997; Harter, 1978; Seefeldt & Ewing, 1997; Taylor et al., 1999; Ulrich, 2000; Weiss et al., 1986). The final regression model contained the variables of gender, pre-intervention PPC, and age, as predicting 37% of the variance in pre-intervention OC scores. Although the variable of risk factors was entered into the regression equation in the third position of predicted importance, this variable was the first to be removed from the equation explaining OC scores. This result was not completely surprising due to the difficulties involved with collecting risk factor data. Collection of accurate risk factor data is problematic due to the sensitivity of this information. Caregivers may be hesitant to report family factors such as substance abuse, physical abuse, and neglect. Teachers may not be privy to such information, and/or be restricted from sharing such information with researchers. Additionally, one risk factor may not be “equal” to another, and risk factor data forms may not contain categories or specific factors of risk which apply to each individual child. Knowledge of risk factor information is important, however, in designing programs to meet the needs of children. Although this variable seemed relatively unimportant in this analysis, the notion and impact of risk in a child’s life should not be discounted.
Implications for Hypothesis 3

Perhaps most notable regarding the participants for this study were the findings that gender and age were predictive of OC scores. The need for improved physical programming for females has been discussed in the previous section. Age is another important consideration in designing and implementing developmentally and instructionally appropriate movement programs. Movement programs should be implemented throughout the lifespan, however, programs for children birth through 5 years old should become more salient. This point is reflected by the recent release of the national physical activity guidelines for children birth through age 5 years (NASPE, 2002). Teachers of this age group should follow these NASPE (2002) guidelines, which also provide examples of movement experiences for children. Within movement programs, teachers should become more aware of the link between perceptions of competence and a child’s motor development. Identification of and support for children’s risk factors is another issue that should be considered in movement program development. Of the possible risk factors affecting children, poverty is classified as a major risk factor, as it is associated with other risk factors such as poor supervision, poor nutrition, and reduced access to public programs and services (Kozol, 1991; Sallis et al., 1993). Poverty also tends to be associated with physical inactivity (USDHHS, 1996). Teacher’s knowledge of the influence of risk factors in a child’s life may inform programming needs.
Future Research for Hypothesis 3

Future research should continue to examine those factors that predict or "constrain" OC development in order to inform motor skill program development. Future research should also explore both quantitative and qualitative ways for collecting and assessing risk factor information. Additionally, assigning "relative weighting" via numerical representation or theme categories to factors may aid in analysis.

Discussion for Hypothesis 4

It was hypothesized that only the intervention group would have statistically significant pre-intervention to post-intervention improvement in OC scores. Additionally, neither group was expected to exhibit significant change in PPC due to the relatively short intervention period. Prior to intervention, the intervention group was at the 9th percentile in OC skills. Following the intervention, however, the participants significantly improved to the 53rd percentile, with an effect size of .16. These results were not surprising, as research has documented that early motor skill instruction is effective in bringing about positive changes in motor skill development of children (Goodway-Shiebler, 1994; Hamilton et al., 1999; Kelly, Dagger, & Walkley, 1989; Valentini, 1997). To illustrate, by providing motor skill interventions, both Goodway-Shiebler (1994) and Hamilton et al. (1999) found significant Group X Time interactions regarding the motor skill development of preschool children who were disadvantaged and/or at-risk for developmental delays and educational failure. Following a 12-week motor skill intervention, Goodway-Shiebler (1994) determined that children who received the intervention improved from the 17th to the 80th percentile, whereas children not provided the intervention only improved from the 18th to the 24th percentile. Similarly, Hamilton et
al. (1999) found that following a parent-assisted motor skill program, children in the intervention group improved from the 20th to the 67th percentile, while children in the comparison group actually declined, from the 18th to the 15th percentile.

This OC intervention was both developmentally and instructionally appropriate. Activities were designed to be modified, therefore meeting the needs of the variety of participants. Additionally, research-based pedagogy formed the backbone of the intervention design (Graham et al., 1998; Rink, 1994; Rink, French, Werner, Lynn, & Mays, 1991; Stroot & Osling, 1993; Sweeting & Rink, 1999). Within the intervention, children were provided: a) practice time for skill development, b) a variety of modifiable tasks, c) clear and brief instructions, and d) cues for tasks. Warm-up activities included rhythms, such as add-on group games; and dance and exploratory movement to music. Object control station activities included modifiable tasks with a variety of equipment, which ensured that every participant had access to her/his own equipment. Additionally, the intervention included cognitive concepts such as counting, naming colors, spelling, shapes, discussion of “working hard,” sharing, cooperating, etc. designed to enhance physical as well as cognitive and social development (Graham, et al., 1998). Children were taught to modify their own tasks in order to be able to practice skills at high rates of success. For instance, in the task of throwing, a child was encouraged to choose her own ball (from among balls of various weights and sizes), place her “spot” at her own distance from the target, and could aim at any of the colored markers on the target. Once she hit her target 5 times, she was allowed to move her spot back a “giant step” and try again. This provision seemed to prevent children from becoming overly frustrated with novel tasks, but also deterred children from becoming bored, as they were encouraged to work
hard and challenge themselves. Also regarding boredom and the short attention span of young children, the children rotated stations every ten minutes, which perhaps contributed to the low rate of misbehaviors. The clarity of cues regarding critical elements of form likely affected OC skill improvement as well. Rink and Werner (1989) suggested that if the teacher has selected and presented these cues appropriately, there should be a direct relationship to the quality of student responses. This seemed to be the case, as few children disregarded the cue “step and throw,” for example. The integrity of lessons was ensured via an intervention integrity instrument, and this consistency among lessons no doubt contributed to the overall gains in OC scores for the participants. The maintenance of intervention integrity was determined to be an important factor in the provision of this intervention, as novice instructional assistants were facilitating activities within stations.

The intervention group evidenced rather large improvements in OC skills in just eight weeks of instruction. From a dynamical systems perspective, the variable of experience/practice may be the key rate-limiter for young children who are exposed to poverty and other risk factors. The groups of participants were similar regarding OC (and PPC) scores at pre-intervention, but at post-intervention, the intervention group gained an average of 15 OC raw points more than did the comparison group. Perhaps the subsystems affecting these children were “ready” to develop their OC skills, but they had not had an opportunity to experience or practice these skills, and this acted as a rate-limiter. Once instruction and practice were provided, the children were no longer limited in this area, and OC gains were large.
In addition to improvements in OC scores, significant improvements were also evidenced for PPC from pre-intervention to post-intervention for the intervention group ($M = 19.74, SD = 2.86$, to $M = 20.38, SD = 2.77$) and for the comparison group ($M = 20.62, SD = 2.54$, to $M = 21.04, SD = 2.69$). These improvements translate into PPC composite score improvement from 3.29 to 3.39 for the intervention group, and from 3.44 to 3.51 for the comparison group. These findings reflect the significant improvements in the Goodway and Rudsill (1996) study, where the intervention group improved from 3.21 to 3.51, and the comparison group went from 3.35 to 3.38 on PPC composite scores following an intervention. Notably, the pre-intervention measures of PPC for both studies were quite high. Room for improvement, therefore, may have been limited by the boundaries of the PPC test. Also, the PPC subscale of the PSPCSA may not have been a good measure of PPC for this specific study. The items measuring this PPC construct did not include OC skills. This subscale questions children regarding swinging on a swing-set, climbing on a jungle-gym, tying shoelaces, skipping, running, and hopping. Perhaps a scale including perceptions of OC skills would have exhibited different results.

*Implications for Hypothesis 4*

The fact that significant improvement in OC scores is possible in as little as 480 minutes of instruction is particularly relevant to physical educators, teachers, and caregivers of young children. Seefeldt (1980) suggested that without practice in fundamental motor skills, children will be unlikely to break through the “proficiency barrier” and move on to efficient performance in games and activities requiring more complex movements and skills. Educators as well as caregivers should be provided with information regarding the benefits of movement as well as practical ideas to incorporate
movement experience into common daily activities with children, such as the Active Start (NASPE, 2002) document. In this study, station facilitators with little training were able to help children significantly improve their OC skills. This brings hope to the notion that, with good support and resources, teachers with little training in motor development and/or movement programs, such as early childhood educators, can make a difference for children.

Future Research for Hypothesis 4

Although this study only investigated OC skills, the children engaged in many locomotor activities during warm-up, within, and/or between stations. It would have been interesting to investigate locomotor improvement as a byproduct of an object control intervention. It is possible that improvements in coordination as a result of OC practice would lead to improvements in locomotor activities as well, due to increased efficiency of movement. Although children improved OC skills from pre-intervention to post-intervention, this research did not investigate this improvement by each skill. It is possible that certain OC skills improved more or less than others. Further, within skills, improvements of specific elements were not investigated. Future research should address OC skill improvement relative to each specific skill, and elements within skills. Additionally, exploration into the development of an OC-PPC instrument would be interesting.

Discussion for Hypothesis 5

Gender differences on post-intervention OC scores and PPC scores within the intervention group were not expected. As hypothesized, both males and females improved their OC scores to a similar degree. This result brings hope to the efficacy of
motor skill intervention for young children, but especially for young girls. Recall that females tend to lag behind males in motor skill development, and especially in skills of object control (Ulrich, 2000). Prior to the intervention, gender differences were found regarding OC skills, with males in the intervention group scoring nearly four raw points higher than females in the intervention group. Yet, following the intervention, no gender differences were evidenced. Returning to the discussion of rate-limiters from the previous research question, perhaps the variable of practice as a rate-limiter for females is especially salient for this population. When provided the opportunity, females in the intervention group “caught-up” to the OC rate of development of the males. Although there was a four point difference in OC raw scores between the females ($M = 14.19, SD = 5.80$) and males ($M = 18.00, SD = 6.40$) prior to intervention, only one point separated the females ($M = 28.50, SD = 7.92$) and the males ($M = 33.46, SD = 9.07$) at post-intervention.

Girls and boys should be provided equal access and opportunities to participate in all types of activities, including OC activities such as dribbling, striking, and throwing. Consistent with the instructional and developmental literature, an intention of this intervention was to encourage, support, and socialize the children to achieve success irrespective of gender. Although data were not gathered on equality of feedback patterns regarding gender, the primary researcher monitored each session in an attempt to ensure a supportive learning environment for the participants. Perhaps for the many of the girls, this support provided additional incentive to participate fully in the activities and to master OC skills. As discussed regarding research question 2, some females in the intervention group began the OC intervention tentatively. At first, these girls tended to do
more watching than participating, which supports the findings of Garcia (1994). As the intervention progressed, however, the girls seemed as excited about, and willing to engage in tasks with as much enthusiasm as many of the boys. Based upon the primary researcher’s informal observations, the provision of positive reinforcement and encouragement seemed to have a greater impact on the girls than on the boys. For example, when some of the boys were given positive feedback for performance, they were so focused upon the task and continued participation that they often did not even acknowledge the feedback. Some of the girls, on the other hand, tended to make eye contact with the teacher, momentarily suspend performance to listen, and smile. As Hutchinson (1993) suggested, this intervention did not group students by gender or ability, maximized fairness and cooperation, and promoted equity in the gym. Perhaps the utilization of these procedures equalized the opportunities for both genders, positively affecting skill learning and acquisition for both girls and boys.

Similar to the findings for PPC in research question 4, gains for PPC were not found to differ between boys and girls. Additionally, there were not differences between genders at pre-intervention. The intervention, therefore, likely worked equally well for boys and girls regarding PPC. Returning to the discussion of the development of perceived competence from research question 2, four psychological constructs are thought to influence the development of perceived competence (Harter, 1978, 1982, 1988). These children had limited past experiences in OC activities prior to intervention. Following the intervention, however, the boys and girls in the intervention group acquired 480 minutes of experience. The second factor, difficulty of challenge associated with the task or performance, perhaps was somewhat affected as a result of the children
learning to self-modify tasks in order to achieve success. Once the children achieved success at a task, they were encouraged to modify the task to challenge themselves. Often, modifications included changing equipment (such as ball size, weight) and/or changing proximity to the target (by moving the individual’s “spot” closer or further). This control over conditions leading to performance may have influenced participants’ perspectives regarding their ability to achieve task success. The third factor regarding reinforcement and personal interactions with significant others regarding performance, it seemed as though boys and girls were benefiting from the personal attention and feedback of the teacher and station facilitators. As the children entered the gym each session, it was difficult to maintain order, as the children were so excited to see their OSU friends, and often ran to give hugs. Throughout the intervention, the primary researcher anecdotally noted some specific and general instances of children’s obvious admiration of and enjoyment with their OSU friends. It is not possible to comment on intrinsic motivation, as this study did not assess this variable. Perhaps of the four factors mentioned, the factor of reinforcement and interaction with significant others regarding activity is the most likely to have been affected by this intervention. Research on risk factors has demonstrated that the presence of a significant other in a child’s life can act as a protective factor, thus reducing some negative effects of risk in a child’s life over time (Berk, 2000; Kazdin, 1995). It may be that children in the intervention looked to the station facilitators as significant others. Often, children would attempt to replicate the performance of the facilitators (OSU friends), and in some cases, even dress in the same
style that some of the facilitators represented (extra long shorts, various neck and wrist jewelry, distinctive nail décor). Prior to attempting a skill, children would often call to their OSU friends to watch the performance.

Implications for Hypothesis 5

Results of this study indicate that motor skill intervention is effective in improving the OC scores of children who have delayed motor skills. Additionally, both boys and girls benefit from intervention. As a group, when provided the opportunity and the instruction for the development of OC skills, girls caught up to the performance of the group of boys, as indicated by the result of no statistically significant gender differences at post-intervention.

Future Research for Hypothesis 5

Future research should investigate girls’ “catch-up” effect when they are provided OC instruction. Additionally, research should examine what types of pedagogies tend to work best for females regarding motor skill development. Future research should examine how feedback, intended as positive reinforcement, provided during motor skill instruction affects children of different genders. Future research should examine the development of PPC in OC skills regarding each of the four constructs influencing perceived competence as identified by Harter. Additionally, future research attempting to link perceived physical competence and actual motor performance should span a time period greater than eight weeks, due to the nature of psychological variables.

134
Discussion for Hypothesis 6

For the intervention group, it was hypothesized that pre-intervention OC score, gender, age, risk factors, post-intervention PPC score, BMI, grip strength, and pre-intervention PPC score would explain a substantial percent of the variance in post-intervention OC skill scores following the intervention period. Variables were ordered in sequence of predicted importance, based upon the research literature. Pre-intervention OC score was positioned as most important, as it seems logical that pre-intervention and post-intervention scores would be related. Gender, age, and number of risk factors remained in the same regressional order as at pre-intervention, as the literature supports these variables as influential in OC performance (Baumgartner & Strong, 1994; Seefeldt & Ewing, 1997; Taylor et al., 1999; Ulrich, 2000; Weiss et al., 1986). The variable of post-intervention PPC was ordered next, as perceived and actual physical performance have been found to be related (Goodway & Rudisill, 1997; Harter, 1978; Weiss et al., 1986), and it seems logical that post-intervention PPC scores would be more important than pre-intervention PPC scores in predicting post-intervention OC scores. The variables of BMI, grip strength, and finally pre-intervention PPC scores followed in order of predicted importance. Correlational patterns indicated that the variables of pre-intervention OC score ($r = .60$), Gender ($r = .31$), and BMI ($r = -.30$) were most related to post-intervention OC score. Together, all of the predictor variables accounted for 61% of the variance in post-intervention OC scores. As hypothesized, the variables of pre-intervention OC score, gender, post-intervention PPC score, BMI, and pre-intervention PPC substantially ($R^2 = .60$) contributed to the regression equation for post-intervention OC score. It was not surprising that the variables of pre-intervention OC scores, gender,
and post-intervention PPC scores remained in the regression equation, based upon prior
discussion. However, the variable of BMI not only remained in the regression, but was
also one of the highest correlators with post-OC scores for the intervention group. At pre-
intervention, the variable of BMI was the second variable to be removed from the
regression equation. As the BMI score relates to efficiency of movement (Malina &
Bouchard, 1991), perhaps because skilled motor performance depends in part upon
efficient movement, children who evidenced higher post-intervention OC scores were
aided by lower BMI. Interestingly, the variables of age and number of risk factors were
not helpful in explaining post-intervention OC score for the intervention group. From a
dynamical systems perspective, perhaps the intervention was effective in buffering some
of the negative attributions of risk, and additionally, lessening the influence of age.

The notion of risk, in and of itself, is an intriguing concept. Risk factors in a
child’s life can be processes, events, or characteristics that increase the probability that
problems will occur (Kazdin, 1995). Risk factors tend to be additive in nature; that is, the
presence of one risk factor increases the probability that other risk factors will
accumulate. On the other hand, accumulating what Berk (2000) refers to as protective
factors, a child can counteract or negate the ill effects of these inherent risk factors. Berk
(2000) notes three main protective factors that work to change a child’s risk status over
time. These protective factors lead to a child becoming resilient. The first, and quite
possibly the most important, is a flexible, easy temperament. Children who are flexible
tend to be able to act and react according to the demands of their environment. Children
who have an easy temperament are pleasant to be around and tend to make friends with
peers and adults more quickly than children with difficult temperaments. For these
reasons, a child with an easy and flexible temperament may have a greater chance of accumulating a more substantial support system than other children. It is unlikely that the intervention substantially affected temperament, as temperament includes biological as well as psychological components. The second factor Berk (2000) mentions is a warm, supportive relationship with at least one parent. This relationship may inadvertently lead to extra protection from abuse in the household as well as offer support against other risk factors. Again, it is unlikely that the intervention affected child-parent relations. Berk’s (2000) third factor is a mentoring relationship with an adult outside of the immediate family. This relationship may allow a child an escape or an outlet from destructive or abusive situations. It may be that this factor was the most influential of these three in this intervention. Future research should examine such issues. The positive environment and warm relationship with the instructor and station facilitators during this intervention may have acted as the mentoring relationship referred to by Berk (2000).

Considering risk factors in research can also be problematic due to the sensitive nature of this personal information, as discussed relative to hypothesis 3. Accurate reporting of child risk factors must come from a source close to the child, and from a source willing to disclose such personal information. Truly representative information, therefore may be difficult or impossible to acquire for each participant, and may have affected this research.

Because the comparison group did not receive the intervention, it seemed logical to apply the regression equation employed at pre-intervention. With the addition of pre-intervention OC scores and post-intervention PPC scores, the variables were ordered as they were for the pre-intervention equation. The correlation matrix for the comparison
group identified the variables of pre-intervention OC scores \((r = .73)\), gender \((r = .50)\), and grip strength \((r = .33)\) as most related to post-intervention OC scores. Regression results indicated that the variables of pre-intervention OC scores, gender, age, risk factors, post-intervention PPC scores, pre-intervention PPC scores, BMI, and grip strength, accounted for 57% of the variance in post-intervention OC scores. For the comparison group, the regression revealed that only one variable was significantly predictive of post-intervention OC score. The variable of pre-intervention OC score accounted for more than half (53%) of the variance in post-intervention OC score, which was not surprising, given that this group did not receive the intervention. Because the comparison group of participants did not receive the intervention, perhaps they did not acquire the additional protective benefits and/or were not able to overcome the (suggested) rate-limiting effect of little experience in OC activities allowing them to reduce their environmental degrees of freedom. With intervention, as this research demonstrates, it is more likely that teachers and researchers will be able to identify specific rate-limiting variables, and perhaps discover protective factors that may enhance motor development of young children.

**Implications for Hypothesis 6**

Interactions among variables are complex. It is difficult to assign causality to one variable, however, consideration of many variables in explaining OC performance allows researchers to identify significant variables in contributing to performance. It is interesting that following the intervention, the variables of age and risk were no longer predictive of OC skill score for the intervention group. If teachers are able to identify and
understand variables (subsystems) that are related to motor performance, they will be better equipped to design and implement appropriate instructional experiences for children.

Future Research for Hypothesis 6

Regarding the variable of risk, longitudinal qualitative research may expose relevant relationships and patterns of risk related to motor development. Additionally, research on risk and protective factors specific to the learning of motor skills should be conducted.

Summary

This study was undertaken due to: a) concern regarding the OC motor skill development of young girls and boys who are in poverty (Goodway & Rudisill, 1996, 1997, Goodway-Shiebler, 1994); b) the potential relationship between early motor skill development and later involvement in physical activity (NASPE, 2002; USDHHS, 1996, 2000); and c) the implications of early motor skill instruction to meet the developmental needs of young girls and boys who are growing up in poverty (NASPE, 2002). This study confirms prior research (Goodway & Rudisill, 1996; Hamilton, Goodway, & Haubenstricker, 1999), suggesting that by the time they enter school, children who are growing up in poverty already demonstrate developmental delays in fundamental motor skills, which include object control activities. Additionally, this study supports prior research (Ulrich, 2000) indicating that, without intervention, males typically outperform females in OC skills.
From a dynamical systems perspective, interactions among many factors will influence motor skill development (Newell, 1984; Newell & Corcos, 1993; Thelen & Ulrich, 1991). Perceived competence in activity may influence persistence, motivation, effort, expectations, and ultimately, performance (Good, 1987; Martinek & Griffith, 1984; Weiner, 1985). Results from this and other (Goodway & Rudisill, 1996, 1997; Rudisill et al., 1993) studies indicate that young children, including those with delayed motor skills, typically evidence high perceptions of physical competence.

Fundamental motor skill achievement is critical to the overall development of children (Gallahue, 1981; Kogan, 1982; Seefeldt, 1980), and must be taught and practiced (Gabbard, 2000; Haywood & Getchell, 2002; Newell, 1984). This study confirms that OC skills can be significantly improved in as little as eight-weeks (480 minutes) of instruction, and that following intervention, boys and girls demonstrate OC skills at a similar skill level. Without intervention, young children who are delayed in object control skill performance may not overcome these motor skill delays.

**Summary of Findings**

1. The participants of this study were at or below the 13th% in the performance of OC skills prior to an eight-week object control motor skill intervention.

2. The participants of this study evidenced high pre-intervention PPC profile scores (intervention: $M = 3.29$, $SD = 0.48$; comparison: $M = 3.44$, $SD = 0.42$) despite their motor skill delays.

3. Prior to the intervention, female participants scored significantly lower on OC scores (7%) than did male participants (16%).
4. Prior to the intervention period, significant predictors of OC scores were gender, age, pre-intervention PPC scores, BMI, and grip strength ($R^2 = .37$).

5. Participants in the intervention group had significantly higher OC raw scores ($M = 30.24, SD = 8.56$) than did participants in the comparison group ($M = 22.33, SD = 8.21$) from pre-intervention to post-intervention.

6. Perceived physical competence did not significantly improve for either group during the intervention period.

7. Following the intervention, female and male participants in the intervention group scored similarly on OC scores (females: $M = 28.50, SD = 7.92$; males: $M = 33.46, SD = 9.07$).

8. Following the intervention period, the variables of pre-intervention PPC, body mass index, gender, pre-intervention OC scores and post-intervention PPC were significantly ($R^2 = .60$) predictive of post-intervention OC scores for the intervention group.

9. For the comparison group, post-intervention OC scores were significantly predicted only by pre-intervention OC scores ($R^2 = .53$).

Summary of Implications

1. Because participants were at the 13th percentile in OC skill performance prior to the intervention period, teachers and administrators need to become informed regarding early motor skill practices and recommendations such as those of Active Start (NASPE, 2002).
2. Movement experiences for children should become a priority in elementary schools, and especially in urban elementary schools where children tend to have exposure to many environmental risk factors.

3. Teachers and physical educators have a major responsibility to ensure that the females in their classes receive appropriate instruction, incentive, and support for the development of motor skills.

4. Within movement programs, teachers should become more aware of the link between perceptions of competence and a child's motor development.

5. Identification of and support for children’s risk factors is another issue that should be considered in movement program development. Teachers' knowledge of the influence of risk factors in a child's life may inform programming needs.

6. Significant improvement in OC scores of young children is possible in as little as 480 minutes of instruction. Educators as well as caregivers should be provided with information regarding the benefits of movement as well as practical ideas to incorporate movement experience into common daily activities with children, such as the Active Start (NASPE, 2002) document.

7. With good support and resources, teachers with little training in motor development and/or movement programs, such as early childhood educators, can make a difference in the development of motor skills for children.

8. When provided the opportunity and the instruction for the development of OC skills, girls appear to “catch-up” to the performance of boys, who typically perform OC skills at more mature levels than girls.
Summary of Recommendations for Future Research

1. Follow-up research should be conducted regarding the longitudinal effects on both OC skills and PPC after an object control motor skill intervention.

2. Longitudinal research involving preschool and kindergarten-aged children should be conducted regarding the physical and psychological effects of motor skill intervention.

3. Research should be conducted to investigate the effect of administrator and teacher knowledge of the benefits of developmentally and instructionally sound movement programming for children.

4. Future research should explore ways for collecting and assessing risk factor information.

5. Research should be conducted regarding the “relative weighting” of risk factors via numerical representation or theme categories.

6. Research should be conducted to investigate locomotor skill improvement as a by-product of an object control intervention.

7. Future research involving subscales of skills should evaluate improvement by each skill and relative contribution to the subscale, as well as improvements of certain elements within skills.

8. Exploration into the development of an OC-PPC instrument should be conducted.

9. Future research attempting to link perceived physical competence and actual motor performance should span a time period greater than eight weeks, due to the nature of psychological variables.
10. Research on risk and protective factors specific to the learning of motor skills should be conducted.

11. Additional research involving larger numbers of participants, and participants representing several schools, should be conducted regarding OC and PPC variables.

12. Future research should investigate girls’ “catch-up” effect when they are provided OC instruction.

13. In order to improve the research design of this study, replication utilizing random assignment of participants to groups should be conducted.

14. Future research should assess the results of this intervention, as lead by a variety of instructors. Researcher effects may then become known.
LIST OF REFERENCES


153


APPENDIX A

TEST OF GROSS MOTOR DEVELOPMENT-2

OBJECT CONTROL SUBSCALE
Test materials needed for administering the TGMD-2.
### Section I: Identifying Information

- **Name:** Actual
- **Gender:** Female
- **Date of Birth:** 09/11/30
- **Age:** 11
- **School:** Perry Elementary
- **Referral by:** Fred Holm
- **Reason for Referral:**
- **Examiner:** Sarah Bailey
- **Examiner's Title:** Physical Education Teacher

### Section II: Record of Scores

#### First Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Raw Score</th>
<th>Standard Score</th>
<th>Percentile</th>
<th>Age Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotor</td>
<td>54</td>
<td>20</td>
<td>16</td>
<td>5.5</td>
</tr>
<tr>
<td>Object Control</td>
<td>23</td>
<td>13</td>
<td>27</td>
<td>3.3</td>
</tr>
<tr>
<td>Sum of Standard Scores</td>
<td>77</td>
<td>33</td>
<td>43</td>
<td>6.8</td>
</tr>
<tr>
<td>Gross Motor Quotient</td>
<td>0.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Second Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Raw Score</th>
<th>Standard Score</th>
<th>Percentile</th>
<th>Age Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Standard Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Motor Quotient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section III: Interfering Conditions

- **Interfering:**
  - Interfering
  - Not Interfering

- **Items:**
  - B. Hocks Level
  - C. Intermittent
  - D. Intermittences
  - E. Light
  - F. Temperature
  - G. Notes and other observations

### Section IV: Other Test Data

<table>
<thead>
<tr>
<th>Name of Test</th>
<th>Date</th>
<th>Standard Score</th>
<th>TGM2-2 Equivalent</th>
</tr>
</thead>
</table>

*The TGMD-2 Profile/Examiner Record Form, completed for Actual.*
### Object Control Subtest

<table>
<thead>
<tr>
<th>Skill</th>
<th>Materials</th>
<th>Directions</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Ballooning</strong></td>
<td>A 4-in. lightweight balloon, a plastic bag, and a latching toy</td>
<td>Place the ball in the latching toy at the child's level. Tell the child to touch the ball with the dominant hand. Follow a second trial.</td>
<td>1. Dominant hand grabs but above nondominant hand</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Nondominant side of body favours imaginary throw with feet parallel</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Tip and shoulder immediately during release</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Transfers body weight to front foot</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5. Ball contacts floor</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. <strong>Passing</strong></td>
<td>A 6- to 9-inch playground ball, a basketball, and a flat, hard surface</td>
<td>Tell the child to dribble the ball four times without moving his or her feet, using imaginary feet. Ask him to stop dribbling after the third time and catch the ball. Repeat a second trial.</td>
<td>1. Contacts ball with one hand at about ball level</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Pushes ball with bottom foot (not a kick)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Ball contacts surface in front of or to the side of feet on the preferred side</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Maintains control of ball for four consecutive bounce (without having to move the feet to retrieve it)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal Score</strong></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3. <strong>Curl</strong></td>
<td>A 4-in. plastic ball, 10 ft. of clear tape and tape</td>
<td>Mark off two buses of clear tape. The child stands on one bus and the other in front. The ball is underhand. The child is asked to roll the ball towards the bus. Tell the child to catch the ball. The child should try to catch the bus in the time that is between the child's shoulders and the bus. Repeat a second trial.</td>
<td>1. Preparation phase where hands are in front of the body and where the bus is marked</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Arms assume wide reaching for the ball at h.</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Ball is caught by hands only</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal Score</strong></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>4. <strong>KICK</strong></td>
<td>An 6- to 9-inch plastic or playground ball, a flat, hard surface, and tape</td>
<td>Mark off one bus 30 feet away from a wall and another bus 30 feet from the wall. Have the ball on top of the bus, and have the child stand on the other bus. Tell the child to run and kick the ball toward the wall. Repeat a second trial.</td>
<td>1. Rapid continuous approach to the ball</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. An elongated stride or step immediately prior to ball contact</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Balling foot placed even with a slightly backward foot at the back of the ball</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Catches ball with opposite of preferred foot (kneeling or toe)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal Score</strong></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>6. <strong>Overhand Throw</strong></td>
<td>A throw ball, a wall, and 25 feet of clear space</td>
<td>Attach a piece of tape on the throw 25 feet from the wall. Have the child stand behind the 25-foot tape facing the wall. Tell the child to throw the ball hard at the wall. Repeat a second trial.</td>
<td>1. Windup is followed with downward movement of hands</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Visually identify passer's time where the nonthrowing side faces the wall</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Weight is transferred by stepping with the foot opposite the throwing hand</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Follow-through beyond ball release diagonally across the body toward the nonpreferred side</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal Score</strong></td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

**Objective Control** Subtest Raw Score (sum of the 6 skills) **27**
APPENDIX B

PICTORIAL SCALE OF PERCEIVED COMPETENCE
AND SOCIAL ACCEPTANCE
PERCEIVED PHYSICAL COMPETENCE SUBSCALE
The Pictorial Scale of Perceived Competence and Acceptance for Young Children

Plates — Preschool and Kindergarten. Female
Susan Harter and Robin G. Pike
In collaboration with Carole Efron and Christine Chao
Illustrated by Deborah Kolbo Ellsworth
1980

University of Denver

INSTRUCTIONS

The child is given a sample item at the beginning of the booklet and instructed as follows:

I have something here that's kind of like a picture game and it's called WHICH GIRL IS THE MOST LIKE ME. I'm going to tell you about what each of the girls in the picture is doing.

Sample: In this one (examiner then points to picture on the left), this girl is usually kind of happy, and this girl (examiner points to the picture on the right) is usually kind of sad. Now, I want you to tell me which of these girls is the most like (Child's Name).

After the child has pointed to the picture appropriate for her, the examiner points to the circles directly below that picture and emphasizes the key qualifying words to help the child refine her choice further. The examiner should always start with the extreme (larger) circle and proceed to the smaller circle. Thus, if the child points to the happy picture in response to the question concerning which is most like her, the examiner would say:

Are you always happy? (pointing to the larger circle)

Or are you usually happy? (pointing to smaller circle)

Occasionally a child will point to the middle of the two pictures and say that both are like her. The examiner should then say: Yes, sometimes we do feel both ways, but if you had to pick, which one of these girls is the way you are most of the time, which one would you choose?

The number value corresponding to the child's choice should be recorded on the Scoring Sheet for Individual Child Responses. Any comments should be recorded in the space provided at the bottom of the sheet.

The examiner continues for each plate, reading the descriptions, verbatim, as she/he points to the picture accompanying each description. In some pictures there is a target child central to the description, designated by an arrow pointing to that child. Be certain that on these items you point to that particular child.
ITEM a

This boy isn't very good at swinging by himself. Are you:

Not too good  OR  Sort of good

Not too good  OR  Sort of good

Pretty good  OR  Really good

Pretty good  OR  Really good
ITEM 7

This boy is pretty good at climbing. Are you:

4 Really good at climbing
3 Pretty good

This boy isn't very good at climbing. Are you:

2 Sort of good
1 Not very good at climbing
ITEM 11

This boy isn't very good at tying his shoes. Can you:

Not tie them at all OR Not too good

1  2

This boy is pretty good at tying his shoes. Are you:

Pretty good OR Really good at tying shoes

3  4
ITEM 15

This girl is pretty good at skipping.
Are you:
Really good at skipping  OR  Pretty good

This girl isn't very good at skipping.
Are you:
Sort of good  OR  Not too good at skipping
ITEM 19

This girl can't run very fast. Are you:
Not very fast           Or           Sort of fast
1
This girl can run pretty fast. Are you:
Pretty fast           Or           Really fast
2
3
4
ITEM 23

This girl is pretty good at hopping on one foot. Are you:

Really good at hopping

4

OR

Pretty good

3

This girl has trouble hopping on one foot. Can you:

Not too good

2

OR

Not hop at all

1
APPENDIX C

RISK FACTORS WORKSHEET
Risk Factors Worksheet

* Risk Factors from Michigan Department of Education

Child’s Name: _________________________ Child’s Teacher: _________________________

* Please place a check beside all known risk factors present in the above-named child’s life.

- Serious concern expressed by a parent, primary caregiver, or professional regarding a child’s development, the parent’s style of parenting, or parent-child interaction.
- Parent or primary caregiver with chronic or acute medical illness, developmental disability, or mental retardation.
- Parent or primary caregiver with drug or alcohol dependence.
- Parent or primary caregiver with a developmental history of loss and/or abuse.
- Family medical/genetic history characteristics.
- Parent or primary caregiver with severe chronic physical illness.
- Acute family crisis.
- Chronically disturbed family interaction.
- Parent-child or primary caregiver-child separation.
- Adolescent mother.
- Parent has four or more preschool children.
- Family income up to 200% of federal poverty guidelines.
- Presence of one of the following: parent education less than 9th grade, neither parent employed, single parent.
- Physical or social isolation and/or lack of adequate social support.
- Lack of stable residence, homelessness, or dangerous living conditions.
- Inadequate family health care or no health insurance.
- Limited prenatal care.
- Maternal prenatal substance abuse.
- Severe prenatal complications.
- Severe perinatal complications.
- Asphyxia.
- Very low birth weight.
- Small for gestational age.
- Bronchopulmonary dysphasia.
- Excessive irritability, crying, or tremulousness on the part of the infant.
- Atypical or recurrent accidents involving the child.
- Chronic otitis media (inflammation or irritation of the middle ear).

**TOTAL NUMBER OF RISK FACTORS**

171
APPENDIX D

SAMPLE PARENTAL CONSENT LETTER

172
Dear Parent and Child:

My name is Heather Savage. I am a Ph.D. student enrolled in the Sport and Exercise Education program at The Ohio State University under the supervision of Dr. Jackie Goodway. As part of my studies I am interested in working on a research study to examine the influence of a physical education program.

You are being asked to allow your child to participate in this study. Your child’s teacher has agreed to work with me on this study. This physical education study “The influence of an object control motor skill intervention on the motor skill development of preschool and kindergarten children who are attending an urban elementary school” will be conducted during physical education class for the next eight weeks of school. The purpose of this study is to gather information to improve movement skills in preschool and kindergarten children. In order to be able to judge the effectiveness of the motor skill program, however, one group of children will receive the motor skill intervention while the other group of children will act as a comparison group. The children who do not receive the instruction during this eight-week period of time will receive opportunity to participate in the motor skills program at a later time during the school year.

Movement skills are used in variety of sports and games. Your child will benefit from this study by learning about and practicing their catching, throwing, kicking, dribbling, striking, and rolling skills. Physical education teachers and other teachers may also benefit by learning about how to help young children learn movement skills.

Your child will participate in physical education twice a week for 45 minutes for eight weeks. During physical education your child will receive instruction on catching, throwing, kicking, dribbling, striking, and rolling skills. We will assess your child’s current skill ability, how skilled they think they are at physical activity, and their physical fitness level at the beginning and end of the program. This assessment will take approximately 32 minutes. And will be divided into two days. During this time your child will be asked to demonstrate the skills of catching, throwing, kicking, dribbling, striking, and rolling. Your child will also be asked six questions about how good they think they are at physical activities. We will then weigh and measure your child and ask them to squeeze an instrument, which measures their grip strength. Your child will be videotaped during the testing sessions. Your child’s physical education class will also be videotaped at times during the course of the study. Only the researcher to study each child’s movement skill performance will use the videotapes. While participating in this study, your child’s risk of injury is no greater than that of any typical physical education activities.
The results of your individual child and this study are available to you, if you wish. The results of this study may be published, but the school or name of your child will never be mentioned. All information about your child will be kept confidential. Each child will be assigned a number. Throughout the study no names will be recorded with the data. Your child’s participation in this study is voluntary and is in no way connected to his/her standing in school. Your child can be withdrawn from the study at any time.

We believe your child will enjoy and benefit from participating in this study. Please keep this letter for further reference. Please sign and return the attached permission slip to your child’s teacher by Monday, September 24th. Thank you for your time. If you have any questions you can reach Heather Savage at 299-2491 or Dr. Goodway at 292-8393.

Sincerely,

Dr. Jackie Goodway
goodway-shiebler.1@osu.edu
292-8393

Heather Savage
savage.75@osu.edu
299-2491
APPENDIX E

HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD APPROVAL TO CONDUCT RESEARCH
**Principal Investigator**

- **Name:** Jacqueline D. Goodway
- **Phone:** 614-292-8393
- **Department or College:** School of Physical Activity & Educational Services
- **College of Education:**
- **Campus Address (room, building, street address):** 309 Pomerene Hall, 1760 Neil Avenue, Columbus, OH 43210
- **Signature:**
- **Date:** Aug 23, 2001

**Co-Investigator**

- **Name:** N. Heather Savage
- **Phone:** 614-299-2491
- **Campus Address (room, building, street address) or Mailing Address:** 309 Pomerene Hall, 1760 Neil Avenue, Columbus, OH 43210
- **Signature:**
- **Date:** Aug 23, 2001

**Protocol Title**

- The Influence of an Object Control Motor Skill Intervention on the Motor Skill Development of Preschool and Kindergarten Children who are Underserved.

**Source of Funding**

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**For Office Use Only**

- **Approved:** Research has been determined to be exempt under these categories:
- **Disapproved:** The proposed research does not fall within the categories of exemption. Submit an application to the appropriate Institutional Review Board for review.

**Date of determination:** 8/11/2001

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176
APPENDIX F

COLUMBUS PUBLIC SCHOOL BOARD

APPROVAL TO CONDUCT RESEARCH
November 21, 2001

Dear Administrator:

I write this letter to introduce Jacqueline Goodway, a researcher from The Ohio State University. Ms. Goodway's research proposal, "The Influence of an Object Control Motor Skill Intervention on the Motor Skill Development of Preschool and Kindergarten Children who are Underserved," has been reviewed and approved by the Research Proposal Review Committee.

This letter does not obligate you to participate in the study. Rather, it serves as an introduction and official notification that the researcher has followed established procedures and has been granted permission to solicit subjects to participate in the study.

If you have any questions or concerns, please contact my office.

Sincerely,

Maurice D. Blake
Maurice D. Blake, Executive Director
Department of Pupil Services

MDB/hlm
cc: Bonnie Strykowski
    Sandi Brennan
November 21, 2001

Don Cramer
The Ohio State University
College of Education
110 Arps Hall
1945 North High Street
Columbus, OH 43210-1172

Dear Mr. Cramer:

I write to inform you that the Research Proposal Review Committee has reviewed and approved the research proposals of George Newell, Anita Roychoudhury and Jacqueline Goodway.

Anita Roychoudhury: Bonnie Strykowski has requested the results when this study is complete. Also, a reminder that IRB needs to be OK and permission slips are signed.

I am enclosing the necessary letters of introduction. The letters should be forwarded to the researchers so they may be offered to administrators when soliciting participation/subjects for the studies.

Sincerely,

Maurice D. Blake, Executive Director
Department of Pupil Services

MDB/hlm
Enclosures
cc: Bonnie Strykowski
    Sandi Brennan
APPENDIX G

INTERVENTION SCHOOL PRINCIPAL

APPROVAL TO CONDUCT RESEARCH
October 29, 2001

To Whom it May Concern:

As the Principal of Hubbard Elementary School, I have given my consent for Heather Savage, under the supervision of Dr. Jackie Goodway, to conduct a research study to examine the influence of a physical education program on the object control skills of Hubbard Elementary School preschool and kindergarten students, pending the approval of the Columbus School Board.

Informed consent will be obtained from parents of the participant children, and classroom teachers will be informed and asked to allow their students to participate in this study. This physical education study "The influence of an object control motor skill intervention on the motor skill development of preschool and kindergarten children who are underserved" will be conducted during physical education class for the next eight weeks of school. The purpose of this study is to gather information to improve movement skills in preschool and kindergarten children. I realize that in order to be able to judge the effectiveness of the motor skill program, however, one group of children will receive the motor skill intervention while the other group of children will act as a comparison group. The children who do not receive the instruction during this eight-week period of time will receive opportunity to participate in the motor skills program at a later time during the school year.

I realize that movement skills are used in a variety of sports and games, and our students will benefit from this study by learning about and practicing their catching, throwing, kicking, dribbling, striking, and rolling skills. Physical education teachers and other teachers may also benefit by learning about how to help young children learn movement skills.

I realize that students will participate in physical education twice a week for 45 minutes for eight weeks and will receive instruction on catching, throwing, kicking, dribbling, striking, and rolling skills. I also realize that the researchers will assess our students' current skill ability, how skilled they think they are at physical activity, and their physical fitness level at the beginning and end of the program. This assessment will take approximately 32 minutes, and will be divided into two days. Pending parental approval, I give consent for our children to be videotaped during the testing sessions as well as at times during the course of the study. The videotapes will be used only by the researchers to study each child's movement skill performance. While participating in this study, I realize that students' risk of injury is no greater than that of any typical physical education activities.

The researchers have informed me that the results this study will be available to parents, and that if the results are published, the school or name of the participating student will never be mentioned. I realize that all information about participating students will be kept confidential. I also realize that students' participation in this study is voluntary and is in no way connected to his/her standing in school. Students can be withdrawn from the study at any time.

Sincerely,

Teresa Scan, Principal
Hubbard Elementary School
APPENDIX H

COMPARISON SCHOOL PRINCIPAL

APPROVAL TO CONDUCT RESEARCH
Windsor Academy Elementary School

1219 East 12th Ave
Columbus, Ohio

November 15, 2001

To Whom it May Concern:

As the Principal of Windsor Academy Elementary School, I have given my consent for Heather Savage, under the supervision of Dr. Jackie Goodway, to conduct a research study to examine the influence of a physical education program on the object control skills of Windsor Academy Elementary School preschool and kindergarten students, pending the approval of the Columbus School Board.

Informed consent will be obtained from parents of the participant children, and classroom teachers will be informed and asked to allow their students to participate in this study. This physical education study “The influence of an object control motor skill intervention on the motor skill development of preschool and kindergarten children who are underserved” will be conducted during physical education class for the next eight weeks of school. The purpose of this study is to gather information to improve movement skills in preschool and kindergarten children. I realize that in order to be able to judge the effectiveness of the motor skill program, however, one group of children will receive the motor skill intervention while the other group of children will act as a comparison group. The children who do not receive the instruction during this eight-week period of time will receive opportunity to participate in the motor skills program at a later time during the school year.

I realize that movement skills are used in a variety of sports and games, and our students will benefit from this study by learning about and practicing their catching, throwing, kicking, dribbling, striking, and rolling skills. Physical education teachers and other teachers may also benefit by learning about how to help young children learn movement skills.

I realize that students will participate in physical education twice a week for 45 minutes for eight weeks and will receive instruction on catching, throwing, kicking, dribbling, striking, and rolling skills. I also realize that the researchers will assess our students’ current skill ability, how skilled they think they are at physical activity, and their physical fitness level at the beginning and end of the program. This assessment will take approximately 32 minutes, and will be divided into two days. Pending parental approval, I give consent for our children to be videotaped during the testing sessions as well as at times during the course of the study. The videotapes will be used only by the researchers to study each child’s movement skill performance. While participating in this study, I realize that students’ risk of injury is no greater than that of any typical physical education activities.

The researchers have informed me that the results this study will be available to parents, and that if the results are published, the school or name of the participant students will never be mentioned. I realize that all information about participant students will be kept confidential. I also realize that students’ participation in this study is voluntary and is in no way connected to his/her standing in school. Students can be withdrawn from the study at any time.

Sincerely,

[Signature]

Audrie Jackson, Principal

Windsor Academy Elementary School
APPENDIX I

INSTRUCTIONAL SKILL ANALYSIS AND CUE SHEET
Identify the efficiency level currently demonstrated for each skill. Select the corresponding cue in order to prompt the child to demonstrate the more mature pattern of the next efficiency level.

<table>
<thead>
<tr>
<th>SKILLS</th>
<th>EFFICIENCY A</th>
<th>EFFICIENCY B</th>
<th>EFFICIENCY C</th>
<th>CUES</th>
</tr>
</thead>
</table>
| THROW  | Throw looks like "chopping action," Feet remain stationary, No trunk rotation | Wind-up begins near child's ear, As arm moves forward child steps forward with foot on same side as throwing arm, Some trunk rotation | Wind-up begins near child's leg, Arm is brought back and then up near ear, As arm moves forward child steps with opposite foot, Rotation begins in lower body and progresses to upper throughout the action | A: Step and throw  
B: Throw as hard as you can  
C: Step and throw as hard as you can |
| CATCH  | Arms held straight in front until ball contact, Delayed response to ball, Feet stationary | Arms held in front, As ball approaches arms "scoop" under ball to trap it to chest, Sometimes single scoop occurs | Hands held in front, child contacts ball with hands only, Sometimes a single step occurs | A: Watch the ball  
B: Catch with your hands  
C: Hands ready, move to the ball |
| KICK   | Little or no leg wind-up, Stationary position, Foot "pushes" ball, Step backward (usually) after kick | Leg wind-up to the rear, Stationary position, Opposition of arms and legs | Moving approach, Foot travels in a low arc, Arm/leg opposition, Forward or sideward step or follow through | A: Step and kick  
B: Run and kick  
C: Kick as hard as you can |
### Instructional Skill Analysis and Cue sheet (continued)

<table>
<thead>
<tr>
<th>SKILLS</th>
<th>EFFICIENCY A</th>
<th>EFFICIENCY B</th>
<th>EFFICIENCY C</th>
<th>CUES</th>
</tr>
</thead>
</table>
| STRIKE | Horizontal swing, Strike looks like “slamming the door,” Entire body rotates, Feet stationary or some stepping | Upon swinging child steps toward target with the foot on the striking side of the body | Same as previous, only the step occurs with the foot opposite the striking side of the body, Body rotation begins in lower body and progresses to upper throughout the action | A: Stand sideways and strike  
B: Step and strike  
C: Stand sideways, step, and strike |
| ROLL | No backward swing of the arm, feet stationary, little or no trunk bending in attempt to lower the body | Some backward swing of the arm, feet stationary or ipsilateral step, knees bend in attempt to lower the body | Preferred hand swings down and back behind the trunk, strides forward with opposition, bends knees, releases ball close to the floor | A: Get low and roll  
B: Step, low, and roll  
C: Arm way back, step, low, and roll |
| DRIBBLE | Hand(s) stiff and “slapping” of the ball occurs, Eyes downward, little or no control of the ball | Fingertips used to “push” ball most of the time, Eyes downward, Feet stationary or move with the ball; little ball control | Contacts (pushes) ball with one hand and maintains dribble about waist level, Able to look up and dribble, Maintains dribble for at least 4 consecutive bounces | A: Push with your pads  
B: Eyes ahead and push  
C: Walk, look ahead, and push |
APPENDIX J

SAMPLE LESSON PLAN
**OSU MOTOR DEVELOPMENT LESSON PLAN**

GRADE LEVEL: Pre K-K  UNIT: Rolling  TEACHER: H Savage

**Week 1**

<table>
<thead>
<tr>
<th>STATION</th>
<th>LESSON OBJECTIVES:</th>
<th>EQUIPMENT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOAL: Rolling</td>
<td>At the end of this lesson, children will have learned to:</td>
<td>25 Hula hoops, 15 each small and medium-sized balls for rolling, Basket of white foam pins, Masking tape, CD player and CDs</td>
</tr>
<tr>
<td>* Roll a stationary ball from a stationary position so that it travels along the ground * Roll a ball using oppositional patterning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>TEACHING STRATEGIES</th>
<th>MODIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Activities * Rolling pattern * Rolling to partners</td>
<td>Place hoops around the gym at a safe distance from each other. As the class enters the gym, * “When I say go, I would like everyone to find their own hoop and sit down inside.” Point out empty hoops if children are confused. * “Stretch your arms out to the side and see if you are able to touch anyone else.” Make sure that each child has adequate space, and that the children do not move the hoops closer to one another. Emphasize the importance of personal space. * “Today we are going to work on rolling. We will use this skill for rolling toward pins and targets.” Have the children stand up. “Now we are going to practice the rolling motion.” * Have the children hold a pretend ball with their writing hand. “On the signal, we are all going to pretend to roll toward me! Watch me first. The action is STEP, LOW, ROLL (demonstrate).” “Ready, roll in your hoop!” * Continue practicing until the children are comfortable with the rolling motion, and most of them can roll with the step-low-roll pattern.</td>
<td>* provide assistance in finding a hoop * assist with movements * restate instructions</td>
</tr>
</tbody>
</table>
**Teaching Strategies**

* Once the children can roll without a ball, ask them if they think that they can “roll a ball to a partner using the step-low-roll pattern?”
* Tell them to roll very gently at first and count how many times the ball rolls along the ground to their partner without the ball rolling away. “I will watch your practice rolls and hand out a ball to students that look like they will be able to roll gently to partners.” Pair children near one another and hand out balls. “Ready, go!” Continue practicing until most children are comfortable. If the children are ready, go up to 8, 10, etc. **CUE: STEP, LOW, ROLL.**
* “Those ROLLS look pretty good! Now we are going to practice rolling with our rolling stance. Try step with your opposite foot, bring your rolling arm way back, bend down, and roll the ball along the ground (demonstrate). **CUE: STEP, ARM WAY BACK, LOW, ROLL.** Let’s practice rolling to our partners. Ready, roll.”
* Have the children practice rolling to their partners while counting out loud how many times they can roll without losing the ball

**Skill Development**

* Rolling to targets
* Step and roll
* Rolling the ball along the ground
* Rolling for accuracy

* “Today we are going to practice rolling the ball along the ground and smoooshing down the grass (pines). Have one child rolling, and one putting the pins back up, then switch. When I tell you, I would like the rollers to step, arm way back, low, and roll the ball along the ground and try to smooosh the grass. Watch me (demonstrate). Let’s all try it at the same time. Ready, roll.” Repeat this a few times.
* “When you were rolling, I saw that some of you were bouncing your balls toward the grass, and some of your balls did not smooosh the grass. This time make sure that you look at the grass, step, **ARM BACK, GET LOW, AND ROLL GENTLY TOWARD THE GRASS.** Have them practice a few more times.

* Remember: **STEP, ARM WAY BACK, LOW, ROLL ALONG THE GROUND**

**Modifications**

* restate instructions and encourage movement
* model and/or put the child through the movement

* Monitor progress and assist with movements.
Intervention Integrity Worksheet

Directions: Place a (1) for “yes” or a (0) for “no” in the corresponding space. Tally points for each station and divide by 9 for station %; tally total points and divide by 27 for total lesson %.

<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>Station 1</th>
<th>Station 2</th>
<th>Station 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity:</td>
<td>Activity:</td>
<td>Activity:</td>
<td></td>
</tr>
</tbody>
</table>

1. Does instructor provide clear instructions in station? 

2. Does instructor provide demonstration of skills? 

3. Are activities individualized for all students? (provide example) 

4. Do all students have their own equipment? (unless a partner or group activity) 

5. Does instructor provide consistent cue* words? 

6. Does instructor cue* for the next level of efficiency? 

7. Does the instructor use positive-specific feedback? (provide example) 

8. Does the instructor use corrective feedback? (provide example) 

9. Is the full 10-minute period provided for this station? 

*Cue words as noted on Skill Analysis and Cue sheet

Fading Schedule:  
- Week 1- every lesson, every station: At least 90% accuracy  
- Week 2- every lesson, random stations: At least 90% accuracy  
- Week 3- every other lesson, every station: At least 90% accuracy  
- Week 4-8- random lesson, random station: At least 90% accuracy