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THE EFFECT OF VARYING LEVELS OF OVERLEARNING
ON THE ACQUISITION AND RETENTION OF THE OVERHAND THROW
FOR CHILDREN WITH AND WITHOUT MENTAL RETARDATION

DISSERTATION
Presented in Partial Fulfillment of the Requirements for
The Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

* * * * *

The Ohio State University
1999

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ABSTRACT

The concept of overlearning refers to a procedure in which a person practices a skill further after having reached some criterion of success. It is believed that overlearning a motor skill during acquisition will lead to improved long term retention of the information. Little empirical study has been reported with respect to the effect of different levels of overlearning on the retention of motor skills for individuals with mental retardation in comparison to their nondisabled peers.

The purpose of this study was to examine the effect which varying numbers of consecutive trials required to reach a pre-set criterion during acquisition would have on the retention of the overhand throw for children with mental retardation. In addition, the study examined if differences existed between subjects with mild mental retardation and their nondisabled peers with respect to the acquisition and retention of the overhand throw.

A total of 92 subjects (46 with mental retardation, 46 nondisabled; ages 4-7) were assigned to one of four treatment groups, with a four-group, within-subject research design being utilized. The specific standard which was used to ascertain successful acquisition of the skill was the overhand throw task analysis utilized in the Test of Gross Motor Development. Subjects were seen during acquisition until they were able to complete the required number of throws for their treatment group. Retention testing took
place three weeks following the end of the acquisition phase. The dependent measure for both acquisition and retention was the number of trials required to achieve the pre-established criterion for the treatment group. Data were analyzed using a simple analysis of variance. Data were also collected in order to establish procedural integrity, interrater reliability and intrarater reliability. The results indicated that all of these were established.

The results of the study indicated that subjects who were nondisabled were able to acquire and retain the overhand throw in significantly fewer trials than did subjects with mental retardation. However, when comparing the effect of two versus four consecutive trials-to-criterion during acquisition on retention performance, significant differences did not exist, both for subjects with mental retardation and those who were nondisabled.
DEDICATION

To my parents. Ron and Sheila Gillespie.
Without their unconditional love and support, this would not have been possible.
I will never be able to thank you enough for the opportunity you have provided me.
ACKNOWLEDGMENTS

I would like to thank my adviser, Dr. Paul Jansma, for his help in completing this project. His level of support, assistance and insight went well beyond anything that I would have expected in an adviser, and I will always be greatful. I would also like to thank Dr. Dave Porretta and Dr. Jacqueline Herkowitz for agreeing to serve on my doctoral committee, as well as for the advice they provided to me not just in the completion of this document, but throught my tenure at Ohio State.

I would like to thank the students, teachers, and administration in both the Lafourche and Terrebonne Parish School Systems for their assiatnce in completing this study. Also, a special thanks to my colleagues in the Department of Health and Physical Education at Nicholls State University, who were extremely supportive during the completion of this study.

I would finally like to thank my friends here in Columbus, especially Jen, Pete, Maria and Kirk for giving me a bed to sleep on when I had to come to town to work on my dissertation, for agreeing to run around and help me out with things that needed doing when I wasn't here, and for basically making my experience at Ohio State a fantastic one!
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CHAPTER 1

INTRODUCTION

The retention and acquisition of information in varying forms has been an area which has been subjected to much research in the social sciences over the years. As noted by Llewelyn (1974), motivation, physical environment, meaningfulness of material, and maturity of the subject involved have all been examined to determine which of these variables are primarily responsible for an individual's ability to retain information. He notes, however, that the variable which in fact plays the greatest role with respect to information retention is overlearning.

Overlearning refers to a procedure in which a person continues practicing a skill after having reached success (Schmidt, 1988). As noted by Magill (1998), the amount of practice a person devotes to a skill is critical for learning motor skills. It is believed that overlearning of information during the initial acquisition phase, irrespective of the form of material learned, will lead to long-term retention. As Morehouse (1988) notes, increased practice beyond the initial learning criterion results in improved retention performance.

Much of the early study concerning the effect of overlearning on retention focused on verbal learning. For example, Underwood and Keppel (1963) noted the positive
benefits of overlearning on the retention of verbal skills. These authors indicate that it appears that the degree of learning is a major variable involved with respect to the retention of verbal skills. In terms of examining the effect of overlearning on the retention of gross motor activities, authors such as Hammerton (1963) and Melnick (1971) have illustrated the benefit which overlearning has on the retention of motor skills.

Numerous studies have examined the effect of overlearning on the acquisition and retention of motor skills for individuals who are nondisabled (e.g., Kaufman, 1971; Singer, 1980). However, there are few studies which have focused on the impact of how overlearning affects the long-term retention of a gross motor skill for individuals with mental retardation. Of those studies which exist that have used individuals with mental retardation as subjects, results have indicated that, as is the case with nondisabled individuals, overlearning is beneficial to the retention of motor skills (Audic, 1981; Chasey, 1971; Chasey & Knowles, 1973; Morehouse, 1988; Scott, 1971).

One suggestion concerning recommendations for future research in this area came from Scott (1971). He indicated that future studies concerning overlearning and individuals with mental retardation should focus on the utilization of different intervals of overlearning to determine whether longer intervals lead to increases in retention. A study which did examine this issue was conducted by Morehouse (1988). This study attempted to investigate the effect of three levels of overlearning during acquisition (two, three, or four consecutive trials at a pre-established criterion) on the retention of a target throwing task for individuals at three different levels of function (moderate mental retardation, severe mental retardation, and individuals without mental retardation). Results from this
study indicated that the scores of subjects with mental retardation improved as a result of the treatment. Individuals with severe levels of mental retardation, who experienced greater levels of overlearning (three or four consecutive trials at a pre-specified criterion) during acquisition, performed significantly better than those who received less overlearning (two consecutive trials at the criterion). This result illustrates the importance of overlearning for individuals with mental retardation with respect to the retention of a motor skill.

The above mentioned study by Morehouse (1988) differs from previous studies in this area with respect to the length of the acquisition phase. The majority of studies examining the effect of overlearning on retention of motor skills for individuals with disabilities tend to incorporate a pre-set intervention length during acquisition when administering the treatment to subjects. However, problems may exist concerning this method with individuals with disabilities when utilizing a task analysis of a motor skill. For example, Bridges (1992) addresses the issue concerning the potential lack of discriminatory power on an instrument which task analyzes gross motor skills. Individuals with disabilities often exhibit relatively small changes in motor performance which may be difficult to distinguish. As Bridges (1992) notes, with a task analysis procedure such as that presented in the Test of Gross Motor Development (Ulrich, 1985), the ability to determine the difference between two levels on a task analysis of a skill is very difficult. As such, with a pre-specified intervention phase length, subjects will likely have different scores on the scale at the end of a treatment intervention. This leaves the researcher with the problem of determining if the difference between two subjects, one
with a score of two and another of three, is the same as the difference between two other subjects, one with a score of three and the other with a score of four. Because of this, other alternatives for measuring change in performance must be examined.

To avoid this dilemma, Morehouse (1988) utilized a method commonly seen in the literature known as trials-to-criterion (TTC). The TTC method involves engaging in sequential trials of a task until a pre-specified number of successes are obtained by the subject (Chow, 1991). With the TTC method, the pre-established level of performance is set, and subjects receive the treatment until they are able to achieve this criterion. This method allows for the use of any developmental sequence of a fundamental motor skill to be used as the criterion, while eliminating any concern with respect to the discriminatory power of the various stages in the task analysis.

Several studies have examined the TTC method of testing versus the more traditional pre-set intervention length method (e.g., subjects receiving treatment three times per week for five weeks). The results of these studies (e.g., Chow, 1991; Feldt & Spray, 1983; Hooper, 1983; Sorenson, Hooper & Spray, 1982) indicate that the TTC method appears to be a more efficient method of intervention delivery, while remaining an accurate domain score estimator concerning performance changes. Sorenson et al. (1982) cite three advantages to using the TTC method versus the traditional fixed length method which have implications for use when measuring changes in performance for students with disabilities. The authors note that with the TTC method, children are able to test/perform until they have achieved success, irrespective of ability; poorly skilled individuals will take longer to reach the criterion, thereby providing more opportunity for
practice; and TTC will result in a better estimate of the poorer performers' ability. Advantages such as these appear to lend support for utilizing this method when measuring skill improvement for students with disabilities.

**Statement of the Problem**

Public Law 101-476, the Individuals with Disabilities Education Act (United States Congress, 1990b), coupled with Public Law 101-336, the Americans with Disabilities Act (United States Congress, 1990a) has led to increased access and opportunity for individuals with disabilities (Porretta, Gillespie & Jansma, 1996). One way in which this increased opportunity has manifested is an increasing trend toward the inclusion of individuals with disabilities into regular community schools (Downs & Williams, 1994). Inclusion, according to Block (1994), is the practice of educating all students, including students with disabilities, in regular education and regular classes. As such, more and more physical education practitioners in the public schools will, at some point, have a student with a disability placed into their setting. However, due to greater pupil-to-teacher ratios in the regular physical education setting, the student with a disability who is included likely will not receive the same attention and amount of feedback that he/she may have been given in a smaller, segregated adapted physical education setting.

Additionally, the published research literature indicates that individuals with mental retardation tend to be delayed with respect to fundamental motor skill development as compared to their nondisabled peers (Roberton & DiRocco, 1981). As such, information is necessary in order to ascertain how variables such as overlearning can be utilized so
that the student with a disability can successfully be included into the regular physical education setting. Previous research in this area (Morehouse, 1988) found overlearning to be an effective tool in improving the retention of motor skills for individuals with moderate and severe levels of mental retardation. Keeping these results in mind, it stands to reason that individuals with mild levels of mental retardation will also benefit from overlearning when attempting to acquire and retain motor skills. To date, however, little empirical data in the literature have been published to reflect this finding. Additionally, by comparing individuals with mild mental retardation to their same age, nondisabled peers at different levels of overlearning, we can hopefully begin to see whether or not certain amount of extra overlearning during skill acquisition will allow students with mental retardation to exhibit similar levels of retention for a motor skill.

An additional problem arises when we consider that many current physical education practitioners have little preparation for working with students with disabilities. As noted by LaMaster, Gall, Kinchin and Siedentop (1998), current regular physical education practitioners who have had students included into their classes have expressed that they felt inadequately prepared to effectively teach in such a setting. The same authors also note that published literature on inclusion research is limited with respect to the impact of different instructional variables. This lends support for the need to conduct research dealing with instructional strategies designed to facilitate inclusive physical education.

An area of concern with respect to the existing literature in the motor learning area is that it is not applied in nature. Young and Schmidt (1992), in discussing needs for
future research, cite the necessity to conduct motor domain research of a more practical, applied manner. As previously mentioned, there is currently no published literature which examines the effect of varying levels of overlearning on the acquisition and retention of motor tasks for individuals with mild mental retardation in an applied manner.

**Purpose of the Study**

The purpose of the study is to examine the effect which varying numbers of consecutive trials required to reach a pre-set criterion (two versus four consecutive trials) during acquisition will have on the retention of the overhand throw for children ages four to seven with mild mental retardation. In addition, the study will examine if differences exist between participants with mild mental retardation and their nondisabled peers with respect to the acquisition and retention of the overhand throw.

**Research Questions**

Based on the purpose of the study, the following research questions are addressed:

1. Do varying numbers of consecutive trials required at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?

2. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of
the overhand throw, as measured by the number of trials required to reach the criterion, for students who are nondisabled?

3. Do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to acquire the overhand throw as measured by the number of trials required to reach a pre-established criterion?

4. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?

5. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?

6. Do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to retain the overhand throw, as measured by the number of trials required to reach a pre-established criterion?

Definition of Terms

Augmented Feedback: Information about performing a skill that is added to sensory feedback and comes from a source external to the person performing the skill (Magill, 1998).

Fundamental Movement Pattern: An organized series of basic movements (e.g., throwing) (Gallahue & Ozmun, 1995).
Inclusion: The practice of educating all students, including students with disabilities, in regular education and regular classes (Block. 1994a).

Mental Retardation: Refers to substantial limitations in present functioning. It is characterized by significantly subaverage intellectual functioning, existing concurrently with related limitations in two or more of the following applicable adaptive skill areas: communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure and work. Mental retardation manifests before age 18 (Luckasson. Coulter. Polloway. Reiss. Schalock. Snell. Spitalnik. & Stark. 1992).

Overlearning: A procedure in which a person practices a skill further after having reached some criterion of success (Schmidt. 1988). More specifically, in this study overlearning consisted of a package of both trials and augmented feedback.

Trial: A combination of a verbal cue, visual cue, and the physical act of throwing a ball.

Trials-to-Criterion: Observing sequential trials of a task until a pre-specified number of successes are obtained by the subject (Chow. 1991).

Assumptions of the Study

1. The normal daily activities of the participants will not affect performance on the overhand throw.

2. The presence of the researcher during data collection sessions will not adversely affect skill performance.
**Limitations of the Study**

All of the participants for the study were students from the Lafourche and Terrebonne Parish School Districts, and were tested on a one-to-one basis. As such, the following are accepted as limitations to the study:

1. Participants for the study will not be randomly selected from the entire population of potential participants. Therefore, the ability to generalize any of the results to similar participants is limited.

2. Data collected will only provide information concerning the overhand throw performance of the participant, and cannot be generalized to overall fundamental motor skill development.

3. Participants in the study may differ with respect to experience in performing the overhand throw prior to participation in the study.

4. Data will be collected in a one-to-one setting involving the participant and the experimenter. As such, transfer of the skill into other settings may be limited.
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CHAPTER 2

REVIEW OF LITERATURE

This section will provide an overview of the published literature as it relates to the concepts of overlearning and inclusion. More specifically, literature will be reviewed dealing with the acquisition and retention of verbal and motor tasks for individuals who are nondisabled and individuals who are mentally retarded. The literature on inclusion will be reviewed as it relates to both general education and physical education.

Overlearning

As mentioned earlier, the variable which perhaps plays the greatest role with respect to long term retention is that of overlearning. The concept of overlearning refers to a procedure in which a person continues practicing a skill after having reached some criterion of success (Schmidt, 1988). Once this pre-established level of performance has been met by an individual, the task is considered to have been learned.

A great deal of published literature has been devoted to examining the effect which overlearning will have on the long term retention of information on a variety of tasks. More specifically, as noted by Llewelyn (1974), the published literature has focused on the examination of the effect which overlearning has on long term retention of verbal information and fine motor skills. Morehouse (1988) notes that few studies in the published literature focus on the relationship between motor skills, overlearning, retention
and mental retardation. He goes on to note that in much of the literature published prior to 1950, nondisabled individuals made up the majority of subjects used in research focusing on overlearning.

When examining the published literature dealing with overlearning, the seminal study which can be found is by Krueger (1929). The author examined the effect of two levels of overlearning (50 and 100 percent) on the retention of 12 monosyllabic nouns. A control group, which performed the task to the pre-established criterion and then stopped, was also utilized. The length of the retention intervals used in this study were one, two, four, seven, 14 and 28 days. Results from the study indicated that the 50 percent overlearning group retained significantly more information across all retention intervals than the control group, with the ratio of the amount retained by each group increasing as the retention interval increased. Relatedly, the author also found that the 100 percent overlearning group retained more information than the 50 percent overlearning group. However, this increase in retention did not appear to be significant, and the author concluded that further increases in overlearning (i.e., from 50 to 100 percent) did not appear to be economical with respect to additional gains in retention. A subsequent study (Krueger, 1930) utilizing a maze tracing task and similar levels of overlearning (zero, 50, 100 and 200 percent) differed from this result, in that 50 percent overlearning did not appear to be the optimal level of overlearning. In this study (Krueger, 1930), the greater the level of overlearning on the maze task, the more long term retention was enhanced.

Postman (1962) also obtained differing results from those found in the first Krueger study. In this study, the author provided subjects with a list of 12 two-syllable words,
with half of the participants receiving a list of high frequency words and the other half receiving low frequency words. The participants were provided with only a single test on the task, versus the first Krueger experiment, where the participants were allowed to practice prior to overlearning. This study (Postman, 1962) utilized a control group, a 50 percent overlearning group, and a 100 percent overlearning group, with retention being measured seven days after acquisition of the list of words. The results of the study indicated that while 100 percent overlearning provided increased retention on both high and low frequency words, 50 percent overlearning had only minimal benefit on the retention of high frequency words, and no significant effect on low frequency retention. The author attributed the differing results from the earlier study by Krueger to the fact that subjects had the opportunity for practice, whereas in this study, the participants were performing at a novice level.

Since the early studies by Krueger (1929 & 1930), much published literature has been devoted to examining the effect which overlearning has on nondisabled individuals. Many of these studies have focused on the acquisition of verbal or written materials. For example, Juola and Hergenham (1967) investigated the effects of overlearning on prediction behavior. Participants were asked, during acquisition, to predict whether a circle or square were to be presented on a cue card at a given ratio (i.e., either a 90:10, 80:20, or 70:30 probability of either a square or circle being presented). The two groups (learning and 200 percent overlearning) were provided with training on this initial problem, and were then tested for retention where the ratio of square:circle presentation was reversed (i.e., if the ratio was 90:10 square:circle during acquisition, then it was
The results of this study indicated that those participants who experienced overlearning during initial acquisition were able to learn the reversed material presented during retention significantly faster than those participants who did not undergo overlearning during acquisition.

There are numerous examples of additional published literature which examine the effect of overlearning on retention for nondisabled individuals (e.g., Craig, Sternhall, & Olshan, 1972; Nelson, Leonesio, Shimamura, Landwehr, & Narens, 1982; Ormrod & Spivey, 1990). These studies have focused on the acquisition and retention of various forms of verbal information (e.g., spelling list words, brand names), and while the methodology and specific verbal information have differed slightly from study to study, the results have been relatively consistent. The relationship in these studies between overlearning and retention can best be summarized by Ausbel (1965) who notes that overlearning during acquisition will increase the absolute level of long term retention of both meaningful and non-meaningful information. The author also notes that greater degrees of overlearning will lead to greater levels of retention than lesser degrees of overlearning. However, the resultant gains in retention are proportionate to the increase in the number of acquisition trials provided. This suggests that there may in fact be an optimal level of overlearning, beyond which additional practice, while still leading to greater long term retention, may not be as beneficial in proportion to the amount of information retained.

In addition to the studies examining the effect of overlearning on nondisabled individuals, published literature has been devoted to the effect which overlearning during
the acquisition of various forms of verbal information will have on long term retention for individuals with mental retardation. For example, Eisman (1958) examined the effect of overlearning on retention for a seven-item paired associate list, which was made up of pictures of common objects. The participants for this study were 69 middle school students assigned to one of three groups: retarded, average, and superior. Assignment to a particular group was based on IQ score. One half of the participants from each group were tested for retention one week after acquisition, with the remaining subjects being tested after a one month retention interval. The results of the study indicated that there were no significant differences between the three groups with respect to both the original learning during acquisition or in the amount of information retained as measured during retention testing.

Ring and Palermo (1961) also examined the effect of overlearning of a paired associate task on long term retention. This study differed somewhat from the earlier study by Eisman (1958) in that participants with mental retardation were matched with nondisabled participants in terms of both chronological and mental age. Results of this study indicated that the participants with mental retardation performed significantly below the level of retention of the nondisabled participants who were the same chronological age. However, when compared to the participants of similar mental age, no significant difference was found with respect to performance during retention.

A similar study examining the effect of overlearning on the retention of verbal paired associates was conducted by Cantor and Ryan (1962). Individuals with mental retardation were matched according to mental age with nondisabled peers. In this study,
the mental age range of the participants (approximately five to eight years) was somewhat lower than in the previous studies discussed. Retention testing was conducted on half of the participants one week after initial acquisition, with the remaining participants being tested following a one month retention interval. Results of the study were similar to previous studies in that there was no significant difference between participants with mental retardation and nondisabled participants with respect to both acquisition and retention of the verbal paired associate task.

A pair of studies by Vergason (1964 & 1966) also examined the relationship between overlearning and retention of a verbal paired associate task. In the first of these studies (Vergason, 1964), 64 individuals with mental retardation and 64 nondisabled individuals were trained on a paired associate task, which was a list of 13 items. One half of the participants overlearned the paired associate list, with the remaining participants simply being required to perform to a minimum learning criterion. The participants were further divided such that one half were asked to relearn the task after one day, while the other half were trained to the original learning criterion after a 30 day interval. Results from the study indicate that there were no differences in the rate of acquisition between individuals with mental retardation and nondisabled individuals. However, the nondisabled participants performed significantly better than the participants with mental retardation on the minimum performance task after one and 30 day intervals. With respect to the overlearning groups, the nondisabled participants performed significantly better with respect to retention after the one day interval, but the difference for the 30 day interval was not significant.
The second study by this author (Vergason, 1966) actually involved data from an earlier study (Vergason, 1964) which were analyzed in a different fashion. In the more recent study (Vergason, 1966), the author notes that most of the early studies (e.g., Eisman, 1958; Cantor & Ryan, 1962; Vergason, 1964) utilized elements of overlearning, which may explain why significant differences between participants with mental retardation and those who were nondisabled did not exist. In this analysis of the data, the author examined the differences between groups on the number of paired associates recalled during the first relearning trial. Results of this analysis indicated that those groups which had overlearned performed significantly better on the first relearning trial than those groups who had only initially learned the task to criterion. Additional analysis indicated that retention was significantly better after the one day retention interval as compared to the 30 day interval. When examining participants with mental retardation versus those who were nondisabled, the data indicated significantly better performance for the nondisabled groups. This result differs from those which have been previously mentioned (e.g., Eisman, 1958; Cantor & Ryan, 1962) in that a significant delay was exhibited by participants with mental retardation. The results of this analysis illustrate the importance of overlearning during acquisition for individuals with mental retardation, as it aids in minimizing the gap between nondisabled individuals with respect to retention of verbal information.

Lance (1965) also examined the effect of overlearning on the retention of a verbal paired associate task with individuals with mental retardation and nondisabled participants. This study differed from previous studies in that the paired associates used
were either considered to have a high degree of meaningfulness or a low degree. The results of the study indicated that participants with mental retardation required significantly more trials to reach the pre-established criterion during acquisition and retention for both high and low meaningfulness paired associates. A similar study conducted by Prehm (1966), which utilized both low and high meaningfulness paired associates, also found significantly superior performance during retention for the nondisabled participants as compared to those participants with mental retardation.

As such, the studies by Lance (1965) and Prehm (1966) were in agreement with the findings of Vergason (1966), in that subjects with mental retardation were found to have a deficit with respect to retention of the verbal task. However, this result is in conflict with those of previous research (e.g., Eisman, 1958; Cantor & Ryan, 1962), who found no significant differences between participants with mental retardation and those who are nondisabled with respect to retention of a verbal paired associate task. It appears, therefore, that while it is accepted that overlearning during acquisition facilitates long term retention of verbal paired associates, some discrepancy exists with respect to the findings comparing participants with mental retardation and nondisabled individuals.

In addition to the numerous studies which have examined the effect of overlearning on retention of verbal information, there has also been literature devoted to the effect which overlearning has on the retention of various motor skills. As was the case with studies utilizing verbal information, much of the initial research focused on nondisabled participants. For example, Purdy and Lockhart (1962) examined the effect which three levels of initial acquisition overlearning (high, average, and low skill performance) had
on the retention of five gross motor skills after a long (nine to 15 month) retention interval. The participants used in this study were 36 college-age females. The results of this study found that, despite the long retention interval, participants in all three groups were quickly able to relearn to their original skill level. Further analysis of the data indicated that participants in the high performance group performed significantly better during retention than the other two groups, and participants in the average performance group significantly outperformed those participants in the low initial performance group. Similar results were found by Ammons et al. (1958) when comparing retention rates after two levels of initial learning (moderate and high levels of performance) of college-age males on a compensatory tracking task.

In another study, Fleishman and Parker (1962) examined the effect of initial learning on the long term retention of a perceptual-motor tracking task. Following an initial acquisition phase, participants were re-tested on the tracking task after one, five, nine, 14 and 24 month retention intervals. The results from this study indicated that, regardless of the length of the retention interval, participants with higher levels of performance during initial learning were able to relearn the task significantly better than those participants at lower levels of performance. In fact, these authors note that the level of performance obtained during acquisition appeared to be the most important factor with respect to retention.

In addition to the above mentioned studies, which have focused on the acquisition and retention of motor tasks which involve tracking activities, research also exists which examines the effect of overlearning on the retention of gross motor skills. For example,
Melnick (1971) examined the effects of overlearning on the retention of a balancing task. In this study, college-age male participants practiced the skill of stabilometer balancing to one of four levels of overlearning (zero, 50, 100 or 200 percent). Follow-up retention testing was performed on half of the participants from each of the four groups following a one week retention interval, with the remaining participants being tested after one month. Results from this study indicated that the groups, who had received overlearning practice during acquisition of the balancing task, exhibited significantly higher immediate retention scores than those participants who only initially learned to the pre-established criterion (i.e., did not engage in overlearning). However, following a brief warm-up period, all groups of participants were able to regain their original level of performance relatively quickly. Further, he noted that 50 percent overlearning was as effective as 100 and 200 percent overlearning, and that significant differences did not exist with respect to the one week and one month retention intervals.

In a similar study, Melnick, Lersten and Lockhart (1972) examined balancing on a stabilometer task for 45 college-age males. Performance of each participant with respect to reaching a criterion level for the task was measured, and then participants were assigned to one of three groups (fast, medium and slow learners) based on the number of trials required to attain this criterion. All participants then received 100 percent overlearning trials on the task. Following a one week retention interval, it was found that while the results favored the faster learners, no statistically significant differences were found between the three groups.
Goard (1979) examined the effect of overlearning on stabilometer balancing for sixth grade boys. Levels of overlearning (zero, 50, 100 and 200), retention intervals (one week and one month) and assignment of participants (half to the one week retention interval, the remaining subjects to the one month group) were identical to the study by Melnick (1971). The results of this study indicated that participants in the 200 percent overlearning group performed significantly better with respect to retention of the stabilometer task than did those with no overlearning across both one week and one month retention intervals. Additionally, immediate recall scores of the 200 percent overlearning participants were significantly better than those of both the zero and 50 percent overlearning groups.

Utilizing a somewhat different task, Schendel and Hagman (1982) attempted to examine the benefit of overlearning on a procedural motor task. In this instance, 42 Army reserve soldiers were assigned to either an overlearning or control group and trained to assemble and disassemble a machine gun. Their ability to retain this skill was tested following an eight week retention interval. Results indicated that the participants in the overlearning group were able to achieve their original level of skill with a significant saving of time in comparison to the control. Additionally, participants who overtrained initially made 65 percent fewer errors than the control group participants.

As the above results indicate, when examining participants who are nondisabled, it is apparent that the overlearning of gross motor skills during acquisition will help to facilitate better long term retention of the task. In addition to the above mentioned studies, published literature has been devoted to examining the relationship between
overlearning and retention of gross motor skills for individuals with mental retardation. For example, Scott (1971) compared participants with mental retardation and those who were nondisabled with respect to the acquisition and retention of a gross motor task. Thirty-six individuals with mental retardation and 36 nondisabled participants, ages five to 13, were asked to perform a balancing task on a stabilometer. Each of the groups of participants (mental retardation and nondisabled) were divided into two subgroups so that half of the individuals received 50 percent overlearning on the balancing task, while the other half of the participants did not receive any additional overlearning during acquisition. Participants were tested for retention following a one month interval. The results of this study indicated that during acquisition, participants with mental retardation acquired the skill at a similar rate to the nondisabled participants, but with overall lower levels of performance. With respect to the follow-up retention testing, results indicated that there was not a significant difference between participants with mental retardation and nondisabled participants. In terms of comparing the overlearning group to the control, the 50 percent overlearning group did not significantly affect retention. However, subjects who were nondisabled performed the balancing task more proficiently and at a faster rate when compared to the participants with mental retardation.

Another study examining the effects of overlearning on the retention of a gross motor skill was conducted by Chasey (1971). This study utilized 98 institutionalized individuals as participants. The task utilized in this study was a modification of the Johnson Mat Test. Participants were assigned to either a learning group (pre-established criterion being met one time) or an overlearning group (pre-established criterion being
met three consecutive times). Retention testing was completed one month after the skill was initially acquired. The results of the study indicated that the participants with mental retardation who overlearned the task during acquisition, exhibited significantly higher levels of retention than did those participants who did not engage in overlearning during acquisition.

In a related study, Chasey and Knowles (1973) examined the effect which overlearning of a gross motor skill (underhand bean bag toss at a target) would have on retention and relearning. Participants for this study were 79 males with varying levels of mental retardation, ages nine to 19 years. One-half of the participants were assigned to a learning group (one consecutive trial at criterion), with the remaining participants being assigned to an overlearning group (three consecutive trials at criterion). Following a five week retention interval, all participants were retested for retention. Results from the study indicated that those participants in the overlearning group performed significantly better on retention than did those participants in the control (learning) group. The authors also concluded from the study the concept that a relationship exists between overlearning and level of retardation (i.e., overlearning appears to be more important for individuals with severe retardation than for those individuals with less severe levels of mental retardation).

Relatedly, Chasey (1977) examined the effect of overlearning on the retention of a stabilometer balancing task, using 100 boys with mental retardation as participants. Participants were assigned to one of four groups (zero, 50, 100 and 150 percent overlearning), and performed the balancing task until the pre-established criterion for the group was attained. Participants were tested for retention following and eight week
interval. Results of this study indicated that, as was the case with earlier studies by Chasey (1971) and Chasey and Knowles (1973), participants who engaged in overlearning during acquisition of the skill exhibited significantly greater degrees of overlearning than the participants with mental retardation who did not receive overlearning trials during acquisition. Further, the group receiving 150 percent overlearning was significantly superior on retention than the 50 percent overlearning group, but not when compared to the 100 percent overlearning group, who also performed significantly better on retention than the 50 percent group.

A study which examined the effect of overlearning on the long term retention of a continuous motor skill (dynabalometer task) was conducted by Audie (1981). The participants used for this study were 30 individuals with mental retardation who were assigned to one of three groups (learning, 50 percent overlearning or 100 percent overlearning). After achieving the pre-established criterion, a 28 day retention interval occurred, which was followed by retention testing. The results of the retention testing indicated that those participants receiving greater levels of overlearning during acquisition retained the task significantly better than those participants at lower levels.

Most of the previously mentioned studies examining the effect of overlearning on retention for individuals with mental retardation have focused primarily on participants with less severe, or mild, levels of mental retardation. One study which examined a somewhat different population was conducted by Morehouse (1988). In this study, participants identified as being moderately (n=10) or severely (n=10) mentally retarded were tested on the ability to retain a discrete motor task (beanbag throwing).
Additionally, 10 nondisabled participants were utilized as a control group. Participants were assigned to one of three groups (two, three, or four consecutive trials at criterion) and performed the throwing task to the appropriate criterion. Follow-up testing took place after a four week retention interval. The results of this investigation indicated that the participants with mental retardation were able to improve their scores on the retention test. More specifically, participants with severe levels of mental retardation, who performed at three and four consecutive trials to criterion during acquisition, performed significantly better than those at two consecutive trials. While the results of the participants with moderate mental retardation were not significant with respect to comparison between the three levels of trials to criterion, the scores for the three and four consecutive trials groups approached significance when compared to the two consecutive trials group. The results of this study again illustrate the role which overlearning during acquisition plays with respect to the facilitation of relearning and retaining a gross motor task for individuals with mental retardation.

Inclusion

As noted by various authors (e.g., Sale & Carey, 1995; Villa, Thousand, Meyers & Nevin, 1996), a significant amount of discussion has taken place for more than a decade regarding changing the way special education services are delivered. Much of this discussion has focused on the use of terms such as mainstreaming, regular education initiative, and inclusion. Early efforts in the reform process relating to special education focused on the regular education initiative, which was, as noted by Taylor, Richards.
Goldstein and Schilit (1997), a movement that proposed the merger of regular education and special education so that students with mild disabilities could be serviced in a more efficient manner. The concept of the regular education initiative was originally proposed by Will (1986), and while the concept initially focused on students with mild disabilities, it soon expanded to address the needs of students with more severe and profound impairments (Villa, Thousand, Meyers & Nevin, 1996).

There were three primary goals advocated by proponents of the regular education initiative, which are outlined by Fuchs and Fuchs (1994). The first goal, as previously mentioned, was to merge special and general education into one inclusive system. The second objective associated with the initiative was to significantly increase the number of students with disabilities in mainstreamed classes through the utilization of large-scale, full-time mainstreaming, as opposed to the traditional segregated, case-by-case approach. The final goal of the regular education initiative involved an improvement in the academic achievement of students with mild and moderate disabilities, along with those students who, although not having a disability, were considered to be underachievers.

From these initial tenets of the regular education initiative, another movement, known as inclusion, has evolved. Both the regular education initiative and the inclusive schools movement have emerged from the concept of mainstreaming, which had the least restrictive environment component of the Education for All Handicapped Children Act as its origin (Sale & Carey, 1995). The inclusion movement expanded upon the goals of the regular education initiative to focus on those students with more severe and profound impairments. As the inclusion movement developed, as noted by Villa and Thousand
(1988), the emphasis was on heterogeneous schools in which all children, regardless of
disability, were educated with the necessary supports in regular classroom settings in
their local school building. In the inclusive school setting, the traditional service delivery
model with respect to curriculum and instruction was modified for all students (Villa,
Thousand, Meyers & Nevin, 1996). For example, advocates of inclusive schools pushed
for the elimination of the continuum of services option available to special education
students, saying that an inclusive school should educate all students in the mainstream
setting (Stainback & Stainback, 1992).

Since the origin of the various strategies aimed at reform of the special education
service delivery system in the United States, a substantial amount of literature has been
focused upon examination of the subject. Unfortunately, research on movements such as
the regular education initiative have, primarily, been based upon opinion and philosophy
statements rather than on empirical data. For example, numerous authors (e.g., Baker,
Wang, & Walberg, 1995; Villa, Thousand, Meyers & Nevin, 1996) note that most of the
debate on mainstreaming, the regular education initiative and inclusion has been
conducted without data, and Sale and Carey (1995) note that there are only a minimal
amount of studies in the literature which examine issues such as student achievement,
social interaction, or social status as relating to students, both with and without
disabilities, in the heterogeneous educational setting. This notion is supported by Sandler
(1999), who notes that there is a lack of empirical documentation in the published
literature for anything other than the social benefits associated with inclusion. As such,
significant research must occur in order to best understand the variables which impact special education before extensive changes or reform to the system is to be implemented.

Inclusion and Physical Education

The debate concerning the inclusive schools movement has, as noted by Villa, Thousand, Meyers and Nevin (1996), extended beyond the special education domain and has become a key issue with respect to the total school reform movement. One of the areas which has been impacted, because of its relationship with special education, is physical education. Within the past five years, there has been a significant amount of published literature devoted to the inclusion of students with disabilities into the regular physical education setting. For example, the January 1994 edition of the Journal of Physical Education, Recreation and Dance (JOPERD) presented a feature on inclusive physical education. The literature included in this feature provided information on a variety of subjects relating to the inclusive physical education setting. Articles in this issue focused on topics such as individualization and adaptation of the regular curricula (Rizzo, Davis, & Toussaint, 1994), strategies for successful heterogeneous physical education settings (Sherrill, Heikinaro-Johansson & Slininger, 1994), collaborative teamwork (Maguire, 1994), strategies for preparing the inclusive school setting (Kelly, 1994), research dealing with inclusive physical education (Block & Vogler, 1994), inclusive physical education in the preschool (McCall, 1994), elementary and secondary (Heenan, 1994) school environments, the impact of inclusion on teacher education.
programs in physical education (DePauw & Goc Karp, 1994), and the overall impact which inclusion will have on the field of physical education (Craft, 1994).

This special feature of JOPERD provided rationale, suggestions and strategies as to how inclusion can work in the physical education setting. An issue of Palaestra which was published in 1994 also provided a forum for authors to discuss the philosophical components of inclusive physical education (Block, 1994b; Sherrill, 1994). However, as was the case when examining the literature on inclusion in the regular classroom setting, there appears to be little research contained within these articles which focuses on the inclusion of students into the regular physical education domain (Block & Vogler, 1994). As such, the rationale, suggestions and strategies presented in these papers are based extensively on philosophical concepts and ideas, which underscores the need for applied research to be conducted as to how best integrate students with and without disabilities in the physical education setting.

Subsequent published literature focusing on inclusive physical education also followed the above-noted trend. Articles in the literature focusing on inclusion in the physical education domain have provided information such as an overview of inclusive physical education (Miller, 1994; Fitzpatrick, 1997), discussion of inclusion research and instructional strategies (Heikinaho-Johansson & Vogler, 1996), the use of peer tutors to facilitate successful inclusion (Block, Oberweiser & Bain, 1995; Houston-Wilson, Lieberman, Horton, & Kasser, 1997), program models utilizing a continuum of supports in order to best facilitate inclusive physical education (Block & Krebs, 1992; Murata & Little, 1995), decisions concerning placement and removal of students from regular
physical education (Block, 1996), the effect of full inclusion on teacher preparation (Sherman, 1997), the social implication of inclusive physical education (Block, 1998), teacher behaviors which will allow for successful inclusion (Block & Brady, 1999), the use of motor development principles to allow the transition into the inclusive physical education setting (Reeves & Stein, 1999), and including students with disabilities in competitive interscholastic athletic programs (Kozub & Porretta, 1996). However, these articles are again almost exclusively based on philosophical concepts and ideas rather than a research base which attempts to address best practice issues relating to inclusive physical education. This continued need for research to be conducted on inclusion in the physical education setting is noted by Heikinaro-Johansson and Vogler (1996).

During the past few years, it appears that this call for research concerning inclusive physical education has been addressed, as studies which have collected empirical data concerning a number of variables relating to inclusive physical education settings have been collected and published in the literature. Block (1995), for example, developed a survey instrument which was designed to measure the attitudes of nondisabled children toward students with disabilities who were included into regular physical education classes. This instrument, the Children's Attitudes Toward Integrated Physical Education-Revised (CAIPE-R), was assessed for construct validity. The results of this examination indicated that the CAIPE-R was in fact a valid measurement instrument by which to assess the attitudes of nondisabled children toward their peers with disabilities in the physical education setting. Additionally, the author also analyzed the data in order to obtain some preliminary information relating to the attitudes of fifth and sixth-grade
students toward integrated physical education. It appeared that overall, nondisabled students responded positively in terms of their attitudes, with three factors (not attending a school with children who had physical disabilities, gender, and having a family member or close friend with a disability) appearing to contribute most favorably to positive attitudes.

A study by Block and Zeman (1996) attempted to ascertain the impact upon nondisabled students when individuals with disabilities were included into a regular physical education class. Three students with severe disabilities were included into a regular sixth-grade physical education class. The attitudes of the nondisabled students, as well as their improvement on basketball skills (passing, shooting and dribbling) were compared to a sixth-grade class which did not have students with disabilities included. The results indicated that there were no differences in gain scores between the two groups (the inclusive group had significantly higher attitude scores than did the noninclusive group prior to the study) with respect to attitudes. In terms of skill improvement, there were no differences between the groups in terms of passing and shooting, while the noninclusive group exhibited greater gains with respect to dribbling improvement.

Sideridis and Chandler (1997) conducted a study which attempted to validate an assessment instrument designed to measure teacher attitudes and beliefs regarding inclusion. Both music education and physical education teachers were used as subjects for the study. The results indicated that the instrument could be utilized as a valid measure with respect to physical education teacher attitudes toward the inclusion of students with disabilities into the regular physical education setting.
Murata and Jansma (1997) examined the impact which peer tutors, physical education teachers and teaching assistants had on academic learning time in the physical education setting for students with disabilities (three students with multiple disabilities) and their nondisabled peers (three students with no disabling conditions). The results of the study indicated that a combination of the physical education teacher and either the peer tutor or teaching assistant aided in facilitating equal participation between the students with and without disabilities. Additionally, it appeared that the students with disabilities did not have a negative impact on the learning environment for the nondisabled students.

A related study which examined the academic learning time of both students with and without disabilities was conducted by Temple and Walkley (1999). Participants were 24 students who were identified as having mild intellectual disabilities and 48 nondisabled students. Numerous inclusive class sessions were observed to ascertain whether differences existed with respect to various levels of physical education participation as delineated by an academic learning time instrument. The results of the study indicated that students with mild intellectual disabilities, both male and female, spent significantly less time engaged in activity than did the nondisabled students at each level of academic learning time being measured.

Another area of research which has recently received increased attention in the published literature has been the perceptions and attitudes towards inclusive physical education by those individuals directly involved on a daily basis (i.e., students, teachers, parents). Maeda, Murata and Hodge (1997) examined the perceptions of Hawaiian
physical education teachers towards the concept of inclusion. More specifically, 52
teachers were surveyed, with 26 responding. The instructors varied with respect to their
level of experience, but over 80 percent had at one point taught a student with a disability.
The results indicated that teachers who had enrolled in graduate-level adapted physical
education courses had more positive attitudes toward inclusion. However, years of
teaching physical education, taking an undergraduate adapted physical education course,
taking graduate coursework in special education, and previous experience working with
students with disabilities did not appear to alter teacher perceptions toward the concept of
inclusive physical education.

O'Connor and French (1998) addressed the attitude of special education
professionals toward inclusive physical education. A survey (the Physical Education
Perceptions of Inclusion Inventory) was administered to 80 special education
paraprofessionals. The results indicated a positive correlation with respect to experience
in teaching physical education classes and knowledge of inclusion, and a negative
correlation relating to number of course hours in college, ratings of inservice training
experiences, and perceptions of inclusion. Further analysis revealed significant
differences between mean knowledge concerning inclusion by length of time worked in
regular physical education, between men and women for years of education, and for years
of experience as a paraprofessional.

Blinde and McCallister (1998) examined inclusion in the physical education setting
from the context of addressing the experiences of students with disabilities in the regular
physical education setting. In this qualitative study, 20 students with varying physical
disabilities were interviewed to ascertain their views and experiences relating to participation in regular physical education. The authors note that while some of the students expressed positive feelings toward physical education, the more common responses elicited highlighted two major outcomes: a) limited participation in activities, and b) negative emotional responses.

A study which examined attitudes toward inclusive participation in a competitive sport setting was conducted by Block and Malloy (1998). This study examined the attitude of nondisabled players, parents, and coaches involved in a female fast-pitch softball league for 10 to 12-year olds. A hypothetical situation, where a player with a disability was to participate in the league, was presented to players, coaches and parents, and these individuals were asked to answer a series of questions regarding their attitudes toward both the inclusion of this individual, as well as their attitudes towards various rule modifications which would best facilitate the participation of the individual with a disability. The results indicated that the attitudes of the players and parents toward inclusive participation and rule modifications were positive, whereas the attitudes of the coaches were less favorable and undecided.

Summary

The findings of the reviewed overlearning studies regarding overlearning can best be summarized by Fitts (1965) who notes that "the importance of practice beyond the point in time where some...criterion is reached cannot be overemphasized" (p.195). There is abundant evidence in the literature to indicate that overlearning during the initial
stages of learning is an important feature in terms of long term retention of verbal information, and both fine and gross motor skills. As noted by Driskell, Willis, and Copper (1992), the published literature has established that overlearning produces an overall moderate improvement in retention, both for physical and cognitive tasks. It appears that overlearning is effective because it provides more training than is required for initial proficiency (Driskell et al., 1992), and also because overlearning allows all learners to perform to a pre-established criterion, which may ensure that initial mastery of a skill or task occurs, thereby enhancing the chances for long term retention. Both of these points bode particularly well for the student with a disability who is going to be included into the regular physical education setting, in that performing a skill to a specific criterion, and then overlearning beyond that point, should greatly facilitate the successful integration into a physical education setting made up of primarily nondisabled peers.

However, despite the significant amount of existent published literature in the area, upon further analysis of the research, some discrepancies become apparent. Although the majority of researchers agree that overlearning is an effective technique for facilitating retention, as Driskell et al. (1992) note in their review of the research in this area, the empirical basis for this claim is not clear at times. For example, as Morehouse (1988) notes, there are contradictions in the literature involving issues such as the varying degrees of overlearning (i.e., zero, 50, 100, 150 and 200 percent overlearning), the original learning criterion (i.e., the number of consecutive correct trials required during acquisition for "learning" to be implied), and the length of the retention interval (i.e., one hour, one day, seven days, twenty-one days, one month, one year, two years, etc.).
Further, as noted by Driskell et al. (1992), it often times appears that many of these variables are set arbitrarily.

Two additional areas of concern noted in the literature by these authors (Driskell et al., 1992) involve the types of tasks investigated and the lack of recent research. The majority of the published literature examining the effect of overlearning on retention appear to be laboratory-based in nature (i.e., paired-associate verbal lists, stabiometer balancing tasks), rather than activities or tasks which are more applied in nature. As such, more study is required with respect to understanding the mechanisms by which overlearning impacts the retention of applied, real world types of tasks, which is what the current study is attempting to answer.

Driskell et al. (1992) also note that there is a significant lack of recent research which has been published in the area of overlearning. These authors note that since the early 1980’s, almost no research has been published. This can, in part, likely be attributed to the fact that there is overwhelming support and evidence as to the benefit of overlearning. However, as noted earlier, much of the published literature on overlearning appears to have manipulated those variables common to the research (e.g., length of retention interval, degree of overlearning) almost arbitrarily. As such, although the benefits of overlearning are well established, there is little information available with respect to prescriptive utilization of overlearning in a practical manner (Driskell et al., 1992). The need to conduct motor domain research in a practical, applied manner is also noted by Young and Schmidt (1992).
Based on these deficiencies in the literature, it appears that there is a need for studies such as the current one, which examines the effect of overlearning on retention in an applied manner. This study becomes even more relevant when the current trend in schools towards inclusion is considered. Student with and without disabilities are being included together not only in the regular classroom setting, but in the physical education domain as well. Numerous authors, both in the regular classroom and physical education settings, have noted the need for applied research to be conducted concerning the variables associated with the inclusion of students with disabilities (e.g., Blinde & McCallister, 1998; Block & Malloy, 1998; Roper, 1991). As such, from the standpoint of physical education practitioners, studies such as the current one which specifically examines the relationship between learning variables (i.e., overlearning) and their impact on both students with mental retardation and nondisabled students can only serve to facilitate learning in the inclusive education setting, as well as providing teachers with research information that can be directly applied in the school setting.
CHAPTER 3

PROCEDURES

This chapter addresses the specific procedures which were undertaken during the course of the study. The information contained here provides detail concerning the research site, the selection of subjects, outcome measures, instrumentation, conditions of testing, research design, and data analysis techniques.

Research Site

Data collection for this study took place in various school buildings in both Lafourche and Terrebonne parishes, which are located in the state of Louisiana. The exact location of data collection varied from site to site (e.g., gymnasium, auditorium stage, empty classroom). Regardless of the specific location, all sites were consistent in that data collection took place in a quiet environment, with only the experimenter and subject being present.

Subject Selection

Prior to the initiation of the study, consent was obtained both from the Ohio State University Behavioral and Social Sciences Human Subjects Institutional Review Board (Appendix A), and the cooperating school districts (Appendix B). As previously mentioned, participants were recruited from two school districts in the state of Louisiana.
The researcher, upon receiving consent from the school districts to conduct the study, contacted local adapted physical educators, special educators, and regular classroom teachers in order to ask if these teachers were willing to have their students participate in the study. The teachers, who were contacted because of their interaction with students with disabilities (i.e., adapted physical educator, special education teacher), were informed that participants with disabilities who were desired as participants for this study were students identified with mild mental retardation who had no known associated disabling conditions. Upon verbal consent that the teachers were willing to allow their students to participate in the study, the researcher provided the teacher with informed consent forms (Appendix C) to send home to the parents/guardians. Following approximately seven to 10 days, the researcher contacted the teacher to determine how many informed consent forms had been returned. At this point, dates and times for data collection were scheduled, and the researcher began the data collection portion of the study. The goal was to obtain a total of 100 participants (25 for each of the four treatment groups) for participation in the study.

**Outcome Measures**

The dependent variable for this study was the number of throws required, both during acquisition and retention, for participants to achieve a pre-established criterion for the overhand throw over a given number of trials. The rationale for using the overhand throw as the fundamental motor skill for this study is outlined by Morehouse (1988). He notes that selection of the overhand throw is desirable because once the basic pattern is
learned, it can be used in a variety of activities; the activity can be conducted almost anywhere; and the task analysis of the skill is easy to follow for the teacher.

For the purposes of this study, the pre-established criterion for successful performance of the overhand throw was defined as the subject exhibiting all four components of the Test of Gross Motor Development (TGMD) (Ulrich, 1985) overhand throw task analysis (Appendix D). Participants were assigned a score ranging from one to four, depending on how many components of the overhand throw were exhibited (e.g., exhibiting two components led to an assigned score of two). This score was assigned by the experimenter. Randomly selected sessions were videotaped in order to evaluate interrater and intrarater reliability, along with procedural integrity. The second evaluator was a certified adapted physical education specialist with extensive experience in evaluating the motor patterns of individuals with disabilities.

**Instrumentation**

The task analysis which was utilized in examining the pattern of the overhand throw exhibited by each subject is the breakdown discussed in the TGMD (Ulrich, 1985). The purpose of the TGMD is to assess the fundamental motor skill development of children ages three to 10 years in terms of the execution of 12 (run, gallop, hop, leap, horizontal jump, skip, slide, two-hand strike, stationary bounce, catch, kick, and overhand throw) fundamental motor skills. The instrument provides both normative and criterion-referenced information concerning the motor patterns being evaluated. Both validity (content and construct) and reliability measures have been reported for the instrument.
Acceptable content validity was established by a panel of three experts, while construct validity was determined by a factor analysis (Ulrich, 1985). With respect to reliability, the test-retest coefficient for the overhand throw was .98 (the range for all 12 gross motor skills was .84 to .99), with interrater coefficients for the throw of .98, .97 and .89 reported (Ulrich, 1985).

With respect to the overhand throw, the TGMD breaks down the overhand throw into four principal components:

1. A downward arc of the throwing hand initiates the wind-up.
2. Rotation of the hip and shoulder to a point where the non-dominant side faces an imaginary target.
3. Weight is transferred by stepping with the foot opposite the throwing hand.
4. Follow-through beyond release diagonally across the body toward side opposite throwing arm.

Due to the nature of the data collection process (i.e., experimenter and participant being the only persons present during data collection), data with respect to procedural integrity were gathered. Procedural integrity of the researcher was established throughout all phases of the data collection process (screening, acquisition, and retention) by the videotaping of randomly selected sessions, which were evaluated by a second observer. This second observer utilized a checklist (Appendix E) to ensure that the principal investigator was consistent with respect to the data collection procedures. A procedural integrity score of at least 95 percent (i.e., the researcher followed the data collection protocol correctly 95 percent of the time) was considered to be adequate for this study.
With respect to reliability measures, interrater reliability was established through the videotaping of randomly selected data collection sessions. Interrater reliability refers to the extent to which different observers give similar ratings to the same behavior (Ary, Jacobs, & Razavieh, 1990). These sessions were then observed by someone other than the researcher. The second evaluator held a master’s degree in adapted physical education, possessed a teaching certificate in physical education along with an add-on certification in adapted physical education, and had extensive experience in evaluating the motor patterns of individuals with disabilities. This second evaluator observed the videotaped data collection sessions and evaluated the throwing mechanics of the subjects utilizing the TGMD task analysis just as the researcher did at the time of data collection, utilizing the same data collection scoresheet (Appendix F). The results of this second evaluator were compared to that of the researcher to determine the percent of agreement between the two individuals. This comparison was accomplished using the score-trial method (Tawney & Gast, 1984), which compares the percent of trials agreed upon against those in which disagreement occurs. The formula for this method is as follows:

\[
\frac{\text{agreements}}{\text{agreements} + \text{disagreements}} \times 100 = \text{Percent of Agreement}
\]

An inter-observer percentage of agreement of 85 percent or higher was considered adequate in order to consider the interrater reliability to have been achieved.

Efforts also were made to ensure that an acceptable level of intrarater reliability was achieved. Intrarater reliability refers to the extent to which the same observer gives similar ratings to the same behavior. Intrarater reliability was established through the
analysis of the same data collection sessions which were videotaped in order to establish
terrrater reliability. Two weeks after the initial viewing of these sessions, both of the
evaluators again observed and rated the performance of subjects on the overhand throw.
The evaluation data relating to the second viewing of the subjects were compared with
the original evaluation data in order to determine intrarater reliability. The technique
which was used to determine the extent of the relationship between the two sets of scores
for each observer was the formula used to calculate a Pearson-Product Moment
Correlation. The formula is as follows:

\[
r = \frac{\sum_{i=1}^{N} (X_i - \mu_X) (Y_i - \mu_Y)}{\sqrt{\sum_{i=1}^{N} (X_i - \mu_X)^2} \sqrt{\sum_{i=1}^{N} (Y_i - \mu_Y)^2}}
\]

Where:
- \( R \) = Pearson r correlation coefficient
- \( N \) = Number of subjects in each group
- \( X \) = Scores from the first observation
- \( Y \) = Scores from the second observation

An \( r \)-value of .7 or above was considered appropriate in terms of establishing
intrarater reliability. The value of .7 is considered to be at the lower end of the range for a
moderate correlation between variables (Vincent, 1995).

Conditions of Testing

Participants were tested individually, with only the participant and the experimenter
being present. The initial data collection session served as an orientation for the
participant. The experimenter determined the preferred throwing arm of the participant
during this session by asking the participants to play catch. The experimenter
demonstrated an overhand throw and asked the participants if he/she could do that. The experimenter then asked the participant to pick up one of the balls lying beside him/her on the floor (three balls were placed beside the participant prior to the start of the orientation) and to throw it to the experimenter in an overhand fashion. The experimenter then asked the participant to pick up a second ball and throw it in the same (overhand) fashion. The exact verbal prompt provided to participants during this portion of the screening was “O.K. (name of student), I want you to throw the ball to me just like I showed you”. If the participant used different hands for the first two throws, a third throw was completed, and the arm that was used by the participants on two out of three throws was considered to be the preferred arm.

In addition, this initial session incorporated a pre-screening in order to determine that all participants used in the study were at similar low beginning levels with respect to their skill on the overhand throw. This screening involved having the participants each perform the overhand throw 10 times in order to establish their present level of performance. The participants’ throwing mechanics were analyzed using the TGMD, and those participants who obtained a mean score of two components or lower for the 10 throws were used as participants for the study, while those who were above this criterion were not utilized as participants. This screening was incorporated to eliminate differences in pre-study ability level between participants, as well as to set the stage for providing intervention to those students whose skill level for the overhand throw appeared to be delayed. Also, prior to actual data collection, pilot testing was conducted in order to determine whether the actual conditions of testing would be appropriate for principal data...
collection. Eight participants (four with mental retardation, four who were nondisabled) were assigned to the four treatment groups, with two participants (one with mental retardation, one who was nondisabled) being placed into each of the groups. The participants were tested using the protocol which had been outlined for the study for both acquisition and retention. Based on the results of this pilot testing, it appeared that the conditions of testing were in fact appropriate to use during principal data collection.

**Acquisition of the overhand throw.** For all four treatment groups, participants were asked to stand 15 feet away from a wall. A large (six feet by six feet) black target was placed on the wall so that the bottom was resting on the surface of the floor. This target was blank with no reinforcing markings (i.e., bulls-eye) present to eliminate any external feedback being provided by the target. Three warm-up throws were provided to the participant, and then the actual data collection began.

When the participant showed up for the data collection session, he/she was greeted by the experimenter. The participant was then told that he or she was going to play a game, and was then handed a ball. The researcher then asked the participant to “throw the ball as hard as you can at the target”. This was repeated three times to complete the warm-up. Each data collection session consisted of 20 throws, unless the participant attained the pre-established criterion before 20 throws were completed. Prior to the participant throwing, the researcher demonstrated the throwing action while explaining to the participant. “Today we are going to play the ball throwing game. What I want you to do is to bring your arm back and down, turn your hip and shoulder, step with your (left/right-opposite) foot, and bring your (left/right-throwing) arm all the way across your
body”. This was done three times. Additionally, prior to each throw, the participant was handed a ball by the experimenter and asked to “throw the ball as hard as you can at the target”. After each throw during the session, each participant was provided with verbal knowledge of performance information, along with a visual cue. This augmented feedback was geared toward directing the individual to focus on the least mature component of the TGMD task analysis which was not displayed. The specific verbal information which was provided was as follows:

a. When no components of the task analysis were displayed: “Good throw! On this throw, I want you to concentrate on swinging your arm down behind you to start the throw”.

b. When the first component of the task analysis was the most mature component displayed: “Good throw! On this throw, I want you to concentrate on turning your hip and shoulder to the side”.

c. When the second component of the task analysis was the most mature component displayed: “Good throw! On this throw, I want you to concentrate on stepping with your (left/right-opposite) foot when you throw”.

d. When the third component of the task analysis was the most mature component displayed: “Good throw! On this throw, I want you to concentrate on bringing your (left/right-throwing) arm all the way down and across your body”.

e. When all four components of the task analysis were displayed: “Good throw! On this throw, I want you to throw the ball exactly like you did on the last throw”.

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This verbal information was also supplemented by visual demonstration. As the researcher provided the verbal information, he also physically demonstrated what the verbal prompt was addressing. After this information was provided, the participant was handed another ball and asked to throw. As such, the intervention provided to each of the participants consisted of a package of throwing trials, verbal prompts, and visual prompts.

Participants were seen three times per week until they were able to meet the pre-established criterion for the specified given number of consecutive throws (two or four), depending upon the treatment group to which they were randomly assigned. The rationale behind the use of either two or four consecutive throws required at criterion was to attempt to standardize the variables associated with respect to overlearning. As previously mentioned, in much of the published literature on overlearning, it appears that often times, the manipulation of variables such as degree of overlearning have been selected arbitrarily. Based on this, the use of two and four consecutive trials at criterion were selected based on their use in previously conducted similar studies in the research literature (i.e., Morehouse, 1988). At this point, the intervention was considered to be complete, with the number of trials required to reach this criterion serving as the dependent measure.

Retention of the overhand throw. To measure the extent to which participants were able to retain the ability to perform the overhand throw, follow-up retention sessions occurred three weeks after the subject had met the pre-established criterion in the acquisition phase. Most studies in the published literature concerning overlearning of a motor task for individuals with mental retardation (e.g., Chasey, 1971; Morehouse, 1988)
typically employ retention intervals which are approximately one month (28-30 days) in duration, with a retention interval of seven days also being seen with some regularity.

There are a number of rationales to support the use of a slightly shorter retention interval duration for this particular study. Evidence in the literature suggests that the retention of a task after one week does not significantly differ from that which occurred after one month (e.g., Cantor & Ryan, 1962). Little evidence can be found in the published research as to why these particular retention intervals are utilized with such frequency. Additionally, with respect to this particular study, a slightly shorter retention interval (three weeks) was selected, in part, due to the nature of the task. Many of the studies previously done (e.g., Chasey, 1971; Chasey & Knowles, 1973; Morehouse, 1988) examining the effect of overlearning on retention for individuals with mental retardation have utilized tasks which have been fairly simple in nature (e.g., tossing a bean bag at a target), and have focused on a quantitative dependent measure (e.g., points scored based on which concentric circle the bean bag lands on). Because the skill being examined (i.e., mechanics of the overhand throw) is somewhat more complex than those examined in previous studies, it was hypothesized that a slightly shorter interval would be more appropriate, while still being long enough to determine the extent to which retention had taken place.

Participants were asked to perform the overhand throw without receiving any external knowledge of performance feedback with respect to the mechanics of the throw. They were asked to throw under the same schedule as during acquisition (i.e., three times per week, three warm-up throws and 20 data collection throws per session) until they
were able to achieve the pre-established criterion for three consecutive throws. If the participant was unable to reach the criterion within three weeks (nine sessions) of this retention phase, the intervention was stopped.

With respect to examining the outcome of the retention phase, two measures were utilized. One measure was the same as during the acquisition phase, in that the number of throws required to reach this criterion for three consecutive throws was calculated for each participant. However, because external feedback was not provided during the retention phase, it was possible that some subjects would not be able to achieve the criterion in the three week timeframe. Because of this, an additional measure of retention performance was necessary. This measure of the amount of retention among groups was the percentage of participants in each group who were able to achieve the criterion during the retention phase. These two scores enabled comparison not only between the four groups in terms of the number of retention trials required to reach criterion, but also allowed examination of any differences between the groups with respect to being able to simply perform to criterion during retention.

**Research Design**

The type of research design which was utilized in addressing the specific research questions was a four-group, within-subject design. Each of the four groups received the same external feedback concerning the mechanics of the throw following each trial. Groups differed according to manipulations of the two independent variables: a) the number of consecutive trials required at a pre-established criterion (two versus four
consecutive throws), and b) level of disability (mild mental retardation versus nondisabled). The four treatment groups were as follows:

1. Two consecutive trials-to-criterion, mild mental retardation.
2. Four consecutive trials-to-criterion, mild mental retardation.
3. Two consecutive trials-to-criterion, nondisabled.
4. Four consecutive trials-to-criterion, nondisabled.

The dependent variable for this study was the number of trials required, both during acquisition and retention, for the participant to reach a pre-established criterion measure of the overhand throw. This criterion was achieved by exhibiting all four components of the overhand throw task analysis contained in the Test of Gross Motor Development (TGMD) (Ulrich, 1985) for the specified number of throws, during acquisition (two or four throws, according to treatment group) and retention (all participants exhibit three consecutive throws).

**Data Analysis**

The data analysis procedure which was utilized in this study was the simple analysis of variance (ANOVA). Two separate ANOVA's were conducted for this study: one to examine the data collected during initial acquisition of the overhand throw, the second to evaluate the retention data. The ANOVA is a statistical procedure which is used to determine whether the differences among two or more means are greater than one would expect by chance alone (Hopkins, Glass, & Hopkins, 1987). For the purposes of this study, the pre-established alpha level to determine if statistical significance between
groups existed was set at .05. If statistical significance between groups existed, post hoc analysis was conducted using the Tukey method. This method of analysis is conducted after a significant analysis of variance finding in order to determine the significance of pairwise cell contrasts (Vincent, 1995). This method of post hoc analysis, as opposed to some of the other commonly used techniques such as the Scheffe' and Newman-Keuls, is appropriate for this analysis in that it is a more conservative test than the Newman-Keuls. yet is not as insensitive to departures from normality and homogeneity of variance (Hays, 1994). The issue of lack of homogeneity of subjects is especially relevant when analyzing group data collected on subjects with disabilities (Bouffard, 1993), which is why the Tukey procedure is more appropriate for this analysis. In addition, the use of the Tukey method was appropriate for this analysis in that equal cell sizes across the four groups were attained.

In addition to the ANOVA, effect size was calculated to determine meaningfulness of the data. This additional analysis was done to address recent concerns in the literature with respect to the use of statistical significance tests as the only means of establishing whether the results of a study are meaningful (Sutlive & Ulrich, 1998). These authors provide alternatives to the singular reliance on statistical significance tests which commonly occurs in adapted physical activity research. One of the recommended alternatives involves the calculation and reporting of effect sizes. As noted by Cohen (1975), effect size refers to the magnitude of the difference between the groups which are being studied. Additionally, Sutlive and Ulrich (1998) note that effect size also provides information with respect to the total variance which is accounted for based on a given
independent variable. There are a number of different strategies available with respect to determining effect size, along with different methods by which effect size values can be interpreted (Sutlive & Ulrich, 1998).

The calculation of effect size is important for a number of different reasons in the adapted physical activity domain. The first rationale for determining effect size involves the use of alpha levels to determine statistical significance. For many years in the behavioral sciences, a pre-established alpha level of .05 has been used to determine statistical "significance". However, as noted by Keppel (1991), the widespread use of this alpha level has simply occurred out of convention or tradition, not for the purpose of rigor. While it is known that the more stringent the alpha level, the greater the level of protection against making a Type I error (rejecting a null hypothesis when in fact it is true), there has been recent discussion in the adapted physical activity literature (Sutlive & Ulrich, 1998) that suggests the utilization of a less stringent alpha level (e.g., .10) because of concerns over the increased possibility of making Type II errors (failing to reject a null hypothesis when it is in fact false). As such, when working with alpha levels in attempting to determine whether or not the results from a study are in fact significant, it may be useful to implement an additional measure, such as calculating effect size, to help account for some of the difficulties associated with conducting research in the adapted physical activity domain (i.e., sample size, field-based research, lack of homogeneous groups).

As noted by Hays (1994), through the determination of effect size, we are essentially attempting to determine how large the effect of the treatment is. For the
purpose of the current study, the determination of effect size will provide information with respect to what extent differing levels of overlearning during acquisition have on the overhand throw. In order to determine this, the method of analysis referred to as omega-squared ($\omega^2$) was used in this study. While there are other techniques which are available to determine effect size from ANOVA data, the $\omega^2$ is recommended because it is a more accurate measure, and is less susceptible to inflation as a result of smaller sample sizes (Sutlive & Ulrich, 1998). The formula for determining $\omega^2$ is as follows:

$$\omega^2 = \frac{(df_A) \times F - (dfA)}{(dfA) \times F + (N-A) + 1}$$

In the above formula, $A =$ the number of levels of the independent variable, $F =$ the numerical F test result, and $N =$ the total number of individuals from the sample. With respect to the interpretation of the $\omega^2$ value, as noted by Keppel (1991) and Sutlive and Ulrich (1998), when examining research in the behavioral sciences, the relative effect sizes are grouped according to small ($\omega^2 = .01$), medium ($\omega^2 = .06$) or large ($\omega^2 = .15$ or greater) effect. These values indicate the guidelines which represent the amount of total variance which can be accounted for by the independent variable.
CHAPTER 4

RESULTS

This chapter addresses the results which were obtained from the data collected in this study. More specifically, this chapter examines the characteristics of the participants and the research sites, measures of reliability and procedural integrity, results from the effect size analysis, and a description of the results obtained from the data related to each research question. An overall discussion of results concludes this chapter.

Characteristics of Subjects and Research Sites

As previously mentioned, participants were recruited from two school districts in the state of Louisiana. After informed consent forms were received, participants were screened in order to equate the four groups prior to intervention. A total of thirteen individuals (all nondisabled students) achieved a score above the minimum criterion for participation, and were thus excluded from the study. Those participants who met the criterion for further participation were then randomly assigned to one of the four treatment groups. Random assignment for each participant was conducted by placing in a hat the names of both groups a particular participant was eligible for (i.e., those participants with mental retardation were only eligible to be selected into one of the two groups of participants for which mental retardation was a characteristic), and then pulling
one of the groups out. The participant was then assigned to participate in that particular
group for the duration of the study.

With respect to specific characteristics of the participants in the four groups, those
individuals in Group 1 (two consecutive trials-to-criterion, mild mental retardation:
2TTC/MR) had a mean age of 6.0 years, with 15 males and eight females. Participants in
Group 2 (four consecutive trials-to-criterion, mild mental retardation: 4TTC/MR) had a
mean age of 6.1 years, with 14 males and nine females. Both of these groups utilized
individuals with mild mental retardation as participants. Due to school district
confidentiality policies, specific information (i.e., IQ scores) was not available for
individual participants. However, all participants were identified by their local school
board as being mildly mentally retarded. With respect to the classification system utilized
by the school districts, participants were identified as being mentally retarded based on
IQ scores. More specifically, students who achieved IQ scores between 55-70 were
classified as being mildly mentally retarded. In terms of the remaining two groups,
participants from Group 3 (two consecutive trials-to-criterion, nondisabled: 2TTC/ND)
had a mean age of 5.75 years of age, with 12 male and 11 female participants. The
participants which comprised Group 4 (four consecutive trials-to-criterion, nondisabled:
4TTC/ND) had a mean age of 5.69 years of age, and as was the case with Group 3,
consisted of 12 males and 11 females. The characteristics of each participant with respect
to age and gender are contained in Table 1.
<table>
<thead>
<tr>
<th>Group 1</th>
<th>Age (years)</th>
<th>Gender</th>
</tr>
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<tbody>
<tr>
<td>1: 5.9 years. male</td>
<td>2. 6.3 years. male</td>
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<td>4: 5.8 years. male</td>
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<td>6. 5.1 years. female</td>
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<td>14. 6.6 years. male</td>
<td>15. 5.5 years. female</td>
</tr>
<tr>
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<td>18. 6.9 years. male</td>
</tr>
<tr>
<td>19: 7.0 years. female</td>
<td>20. 6.6 years. male</td>
<td>21. 6.3 years. male</td>
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<tr>
<th>Group 2</th>
<th>Age (years)</th>
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<tr>
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<td>4: 6.4 years. female</td>
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<td>6. 6.5 years. female</td>
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<tr>
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</tr>
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<tr>
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<td>15. 5.9 years. male</td>
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</tr>
<tr>
<td>22: 6.0 years. female</td>
<td>23. 5.6 years. male</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Characteristics of Research Participants.
With respect to the specific sites in which data collection took place, there were a total of 13 school buildings whose staff allowed their students to participate in the study. Within those 13 buildings, a number of specific areas were utilized during data collection. More specifically, the three areas where data were collected included an empty classroom (41 subjects), the school gymnasium (35 subjects), and the school stage (16 subjects). While there was variation from building to building as to which specific area was utilized, once data collection was initiated for a participant in an area, that setting was utilized for all remaining data collection efforts for that individual.

**Interrater Reliability, Intrarater Reliability, and Procedural Integrity**

In order to ensure that consistent, reliable data were obtained, measures were taken to determine both reliability and procedural integrity. These analyses were conducted through the analysis of data collection sessions which had been videotaped. More specifically, a total of 207 data collection sessions were videotaped during the course of the study. This accounted for 34.7 percent of the 597 total data collection sessions that took place. These sessions were randomly selected by placing the names of the days of a particular week upon which data were going to be collected into a hat. For example, in an upcoming week, if data were to be collected on Monday, Wednesday and Friday, then those three days were written down onto separate pieces of paper and placed into a hat. One of those days was then randomly pulled out of the hat, and data were collected on that day.
Interrater reliability for this study was established by having a second individual observe the videotaped data collection sessions and evaluate the throwing mechanics of the participants utilizing the Test of Gross Motor Development (TGMD) task analysis just as the researcher had at the time of data collection. The results of this second evaluator were then compared to that of the researcher in order to compare the percent of agreement between the two individuals. Based on the interrater reliability data results, it was found that an overall agreement between the researcher and the second observer was 93.76 percent. As an adequate interrater reliability value of 85 percent had been pre-established, it was concluded that interrater reliability had been established.

Reliability data were also collected to ensure the presence of intrarater reliability. As previously mentioned, intrarater reliability refers to the extent to which the same observer gives similar ratings of the same behavior. Both the researcher and the second observer viewed the videotape sessions twice, with a two week interval between viewings, in order to establish intrarater reliability. The scores for each viewing were compared to determine the extent to which there was consistency among the results. A Pearson-product moment correlation was conducted in order to obtain an r-value for both the researcher and the second observer. The analysis of results indicated that the researcher achieved an overall mean r-value score of .834, while the second observer obtained a mean r-value of .793. When compared to the pre-established appropriate r-value score of .7, both the researcher and the second observer obtained higher degrees of relationship between the two evaluations. As such, it can be concluded that intrarater reliability was established for the study.
In addition to measure of reliability being established for this study, an analysis of the videotaped data collection sessions for procedural integrity was also conducted. More specifically, the second observer analyzed the videotapes to ensure that consistent instruction and protocol were used for all participants based on six pre-established criterion (see Appendix E), which were listed on the procedural integrity checklist. Upon analysis of the videotaped data collection sessions, it was found that the researcher was consistent in his presentation of the protocol. More specifically, there were only four sessions, out of 207 data collection sessions which were videotaped, where the experimenter deviated from the assigned protocol. With respect to these instances where procedural integrity was not met, in three cases the subject was not told when the next data collection session would be, and in the fourth case, the experimenter did not record the score for a throw immediately following the throw. In each of these instances, the data collected during that session were not dropped from the study, in that the integrity of the data did not appear to be compromised. This resulted in a procedural integrity score of 98.07 percent, which exceeded the pre-established cut-off of 95 percent. As such, it appears that the integrity of the procedures which were utilized in this study were consistent throughout data collection.

**Results of Acquisition Data**

As previously discussed, participants were assigned to one of four groups to ascertain the effect of varying levels of overlearning during the acquisition and retention of the overhand throw. More specifically, the number of trials required for the individual
to reach the pre-established criterion for the group was considered to be the dependent variable for the study. To summarize, the four specific groups were as follows:

Group 1: Two consecutive trials-to-criterion, mild mental retardation
Group 2: Four consecutive trials-to-criterion, mild mental retardation
Group 3: Two consecutive trials-to-criterion, nondisabled.
Group 4: Four consecutive trials-to-criterion, nondisabled.

After assignment to a group, data were collected and analyzed during the acquisition phase of the study. The mean dependent scores (number of throws required to reach the pre-established criterion per group) for each group were as follows:

Group 1 (2TTC/MR): 62.87
Group 2 (4TTC/MR): 74.17
Group 3 (2TTC/ND): 28.52
Group 4 (4TTC/ND): 42.43

In addition to this descriptive information, data were also analyzed to determine whether significant differences existed between groups. As previously mentioned, the data analysis procedure which was utilized in this study was the simple analysis of variance. The results of this analysis are provided in Table 2.
Table 2: Analysis of variance summary table for acquisition data.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>28808.696</td>
<td>3</td>
<td>9602.899</td>
<td>41.365*</td>
</tr>
<tr>
<td>Within</td>
<td>20429.304</td>
<td>88</td>
<td>232.15</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>49238.0</td>
<td>91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p< .05

The results of the analysis of variance indicate that $F$, with three and 88 degrees of freedom, equals 41.365 and is significant at less than the .05 level. Based on this result, which indicates that significant differences existed between groups, further analysis of the data was warranted.

As was mentioned previously, the post-hoc analysis technique which was utilized in this study was the Tukey method. This method of post-hoc analysis is conducted after a significant analysis of variance finding in order to determine the significance of pairwise cell contrasts (Vincent, 1995). This determination of significance requires that the honestly significant difference (HSD) value be determined. The HSD value was established by multiplying the pre-established table value for $\alpha$ (for this study, $\alpha = .05$) by the square root of the mean square error divided by the number of subjects in each group. For the acquisition data, the HSD value was 11.73. This means that in order to establish significance between groups, the difference between group means must exceed this value. The results of this analysis are contained within Table 3.
Table 3: Tukey post-hoc analysis for acquisition data.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (62.87)</th>
<th>Group 2 (74.17)</th>
<th>Group 3 (28.52)</th>
<th>Group 4 (42.43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0</td>
<td>11.30</td>
<td>34.53*</td>
<td>20.44*</td>
</tr>
<tr>
<td>Group 2</td>
<td>11.30</td>
<td>0</td>
<td>45.65*</td>
<td>31.44*</td>
</tr>
<tr>
<td>Group 3</td>
<td>34.53*</td>
<td>45.65*</td>
<td>0</td>
<td>13.91*</td>
</tr>
<tr>
<td>Group 4</td>
<td>20.44*</td>
<td>31.74*</td>
<td>13.91*</td>
<td>0</td>
</tr>
</tbody>
</table>

*α < .05

Based on the results of this post hoc analysis, five differences exceeded the HSD value, which established statistical significance between the groups. The five significant differences which were found to exist between groups were the difference between Group 1 (2TTC/MR) and Group 3 (2TTC/ND), which favored Group 3 (2TTC/ND), the difference between Group 1 (2TTC/MR) and Group 4 (4TTC/ND), which favored Group 4 (4TTC/ND), the difference between Group 2 (4TTC/MR) and Group 3 (2TTC/ND), which favored Group 3 (2TTC/ND), the difference between Group 2 (4TTC/MR) and Group 4 (4TTC/ND), which favored Group 4 (4TTC/ND), and the difference between Group 3 (2TTC/ND) and Group 4 (4TTC/ND), which favored Group 3 (2TTC/ND). The pairwise comparison showing the greatest disparity was the difference between Groups 2 (4TTC/MR) and 3 (2TTC/ND), which favored Group 3 (2TTC/ND). The only post-hoc comparison between groups which did not achieve statistical significance was that
between Group 1 (2TTC/MR) and Group 2 (4TTC/MR). It should be noted, however, that
the pairwise cell contrast value (11.30) was very close to achieving statistical
significance.

Results of Retention Data

In addition to determining if significant differences existed between groups during
the acquisition of the overhand throw, data were also collected to ascertain whether or not
significant differences were present with respect to the retention of the overhand throw
between groups following a three week retention interval. As was the case during the
initial acquisition phase of the study, the dependent variable during the retention phase
was the number of trials required for the participant to reach the pre-established criterion.
All participants were able to achieve the pre-established criterion for three consecutive
throws during the retention phase of the study. The mean dependent scores for each of the
four groups during the retention phase were as follows:

- Group 1 (2TTC/MR): 57.04
- Group 2 (4TTC/MR): 53.26
- Group 3 (2TTC/ND): 22.26
- Group 4 (4TTC/ND): 17.39

In addition to this descriptive data for all four of the groups, an analysis of variance
was conducted to determine if significant differences existed between groups. Table 4
contains the result of this analysis.
The results of the analysis of variance for the retention data indicate that $F$ with three and 88 degrees of freedom, equals 44.07 and is significant at less than the .05 level. Based on this result, which indicates that significant differences existed between groups, further analysis of the data was warranted. As was mentioned previously, the post-hoc analysis technique which was utilized in this study was the Tukey method. For the retention data, the HSD value was 11.40. The results of this analysis are contained in Table 5.

### Table 4: Analysis of variance summary table for retention data.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>29139.685</td>
<td>3</td>
<td>9713.228</td>
<td>44.707*</td>
</tr>
<tr>
<td>Within</td>
<td>19335.304</td>
<td>88</td>
<td>219.719</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>48474.989</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p< .05

Table 5: Tukey post-hoc analysis for retention data.

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (17.39)</td>
<td>0</td>
<td>3.78</td>
<td>34.78*</td>
<td>39.65*</td>
</tr>
<tr>
<td>Group 2 (22.26)</td>
<td>3.78</td>
<td>0</td>
<td>31.0*</td>
<td>35.87*</td>
</tr>
<tr>
<td>Group 3 (53.26)</td>
<td>34.78*</td>
<td>31.0*</td>
<td>0</td>
<td>4.87</td>
</tr>
<tr>
<td>Group 4 (57.04)</td>
<td>39.65*</td>
<td>35.87*</td>
<td>4.87</td>
<td>0</td>
</tr>
</tbody>
</table>

*α< .05

Table 5: Tukey post-hoc analysis for retention data.
Based on the results of this post hoc analysis, four differences exceeded the HSD value, which established statistical significance between the groups. The four significant differences which were found to exist between groups were the difference between Group 1 (2TTC/MR) and Group 3 (2TTC/ND), which favored Group 3 (2TTC/ND), the difference between Group 1 (2TTC/MR) and Group 4 (4TTC/ND), which favored Group 4 (4TTC/ND), the difference between Group 2 (4TTC/MR) and Group 3 (2TTC/ND), which favored Group 3 (2TTC/ND), and the difference between Group 2 (4TTC/MR) and Group 4 (4TTC/ND), which favored Group 4 (4TTC/ND). The pairwise comparison showing the greatest disparity was between Group 1 (2TTC/MR) and Group 4 (4TTC/ND), favoring Group 4 (4TTC/ND). The post-hoc comparison between groups which did not achieve significance was that between Group 1 (2TTC/MR) and Group 2 (4TTC/MR), and the comparison between Group 3 (2TTC/ND) and Group 4 (4TTC/ND).

Effect Size

As previously mentioned, in addition to the information contained within the ANOVA, the data were analyzed with respect to effect size. This analysis was conducted in order to determine the amount of variance which could be explained by the independent variable. The results of the analysis for effect size with respect to the acquisition data indicated an effect size of \( \omega^2 = 0.576 \). The effect size calculation on the retention data indicated an effect size of \( \omega^2 = 0.549 \). According to the effect size values previously discussed, the calculated effect size is considered to be large in nature. More specifically, it appears that for the acquisition data, 57.6 percent of the total variance was
accounted for by the independent variable, while 54.9 percent of the total variance for the retention data can be accounted for by the independent variable.

Results of Statistical Analysis as Related to Specific Research Questions

The purpose of this study was to examine the effect which varying numbers of consecutive trials required to reach a pre-established criterion (two versus four consecutive trials) during acquisition will have on the retention of the overhand throw for children ages four to seven with mild mental retardation. Additionally, the study was also to examine if differences existed between participants with mild mental retardation and their nondisabled peers with respect to the acquisition and retention of the overhand throw. In order to address these issues, six specific research questions were developed. The data which were collected were analyzed in order to attempt to answer these questions.

The first specific research question asks "do varying numbers of consecutive trials required at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?" The data collected for Group 1 (2TTC/MR) and Group 2 (4TTC/MR) were analyzed in an attempt to answer this question. The mean number of trials for subjects in Group 1 (2TTC/MR) during acquisition of the overhand throw was 62.87, while the subjects in Group 2 (4TTC/MR) required, on average, 74.17 trials in order to reach criterion. Based on the results of the analysis of variance and post hoc analysis conducted on acquisition data (see Tables 1

67
and 2), there was not a statistically significant difference between groups. As such, it appears that varying numbers of trials required to reach criterion do not differ with respect to acquisition of the overhand throw for individuals with mild mental retardation. However, as previously mentioned, according to the post hoc analysis, the differences between Group 1 (2TTC/MR) and Group 2 (4TTC/MR) closely approached statistical significance with respect to this question.

The second specific research question asked “do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?” The data collected for Group 3 (2TTC/ND) and Group 4 (4TTC/ND) were analyzed in an attempt to answer this question. The mean number of trials for subjects in Group 3 (2TTC/ND) during acquisition of the overhand throw was 28.52, while the subjects in Group 4 (4TTC/ND) required, on average, 42.43 trials in order to reach criterion. Based on the results of the analysis of variance and post-hoc analysis conducted on acquisition data (see Tables 1 and 2), there appears to be a statistically significant difference between groups, favoring Group 3 (2TTC/ND). As such, it appears that varying numbers of trials required to reach criterion do differ with respect to acquisition of the overhand throw for individuals who are nondisabled.

The third specific research question asks “do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to acquire the overhand throw as measured by the number of trials required to reach a pre-
established criterion?" The data used to address this question were the analysis of variance and post hoc comparison presented in Tables 1 and 2. This analysis indicates that statistically significant differences existed between subjects with mild mental retardation (Group 1, 2TTC/MR and Group 2, 4TTC/MR) and those who are nondisabled (Group 3, 2TTC/ND and Group 4, 4TTC/ND). In each instance, the groups with subjects who were nondisabled (Group 3, 2TTC/ND and Group 4, 4TTC/ND) significantly required less trials to reach criterion than did those subjects with mild mental retardation (Group 1, 2TTC/MR and Group 2, 4TTC/MR).

The fourth specific research question asked "do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?" The data collected for Group 1 (2TTC/MR) and Group 2 (4TTC/MR) were analyzed in an attempt to answer this question. The mean number of trials for subjects in Group 1 (2TTC/MR) during the retention phase was 57.04, while the subjects in Group 2 (4TTC/MR) required, on average, 53.26 trials in order to reach criterion. Based on the results of the analysis of variance and post hoc analysis conducted on retention data (see Tables 3 and 4), a statistically significant difference does not exist between the groups. As such, it appears that varying numbers of trials-to-criterion during acquisition does not have a significant effect with respect to the retention of the overhand throw for students with mild mental retardation.
The fifth specific research question asked "do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?" The data collected for Group 3 (2TTC/ND) and Group 4 (4TTC/ND) were analyzed in an attempt to answer this question. The mean number of trials required for subjects in Groups 3 (2TTC/ND) and 4 (4TTC/ND) during the retention phase were 22.26 and 17.39 respectively. Based on the results of the analysis of variance and follow-up post hoc testing (see Tables 3 and 4), a statistically significant difference did not exist between groups. It appears, based on this analysis, that varying numbers of trials-to-criterion required during acquisition did not significantly affect the retention of the overhand throw for students who were nondisabled.

The sixth specific research question asked "do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to retain the overhand throw, as measured by the number of trials required to reach a pre-established criterion?" The data which were presented in Tables 3 and 4 were used to address this question. Based on the results of the analysis of variance and post hoc testing of the data, it appears that significant differences existed between students with mental retardation and those students who were nondisabled with respect to their ability to retain the overhand throw. The analysis indicates that students who were nondisabled were able to retain the overhand throw significantly better than those subjects with mild mental retardation.
Discussion

The results of the statistical analysis performed on the data collected in this study present a number of findings warranting discussion. These findings will be addressed in terms of the six specific research questions which were addressed by this study, along with a discussion as to how the findings may impact physical education practitioners in an applied manner.

Prior to addressing the results of the six specific research questions, a discussion of additional analyses of the data is warranted. These analyses were conducted to ascertain whether a) gender differences existed within each of the four groups, and b) to determine whether there were differences between the locations where the data were collected (i.e., classroom, gymnasium, or stage). The results of the first analysis indicated that there were no significant differences between males and females across any of the four groups, both during acquisition and retention. However, the second analysis indicated that there were significant differences between groups according to data collection site. It appeared that those individuals who participated on a school stage setting required significantly more throws during acquisition and retention than did those individuals participating in a classroom or gymnasium. However, it appears that this result can likely be attributed to the nature of participants participating at each site (i.e., there was a greater proportion of participants with mental retardation who participated in the stage setting), rather than actual differences between the sites themselves. The results of the effect size analysis of the data, which confirms that a significant proportion of the variance can be accounted for
by the independent variables, provides support to this conclusion. Nonetheless, it appears that the research location where data were collected may have been a potential contaminant in this study.

The first specific research question asks "do varying numbers of consecutive trials required at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?" The results of this analysis suggest that a significant difference did not exist with respect to the number of trials required to acquire the overhand throw. As previously mentioned, however, the difference between the groups very closely approached statistical significance, with the participants completing two consecutive trials at criterion requiring less trials than those participants who were asked to complete four consecutive trials at the pre-established criterion. The finding that participants asked to complete two consecutive trials at criterion required less trials to complete the acquisition phase of the study than did those participants who were asked to complete four consecutive trials is in congruence with both the nondisabled participants in this study, as well as previous literature examining the effect of overlearning on individuals with mental retardation (Chasey, 1971; Chasey & Knowles, 1973).

The second specific research question asked "do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?" The results of
this analysis indicate that the group which required participants to complete two consecutive trials at criterion acquired the skill in significantly fewer throws than did those participants who were asked to complete four consecutive trials at criterion. This result mirrors much of the published literature regarding varying numbers of trials-to-criterion, in that during acquisition, the group requiring fewer numbers of consecutive trials at criterion typically needs significantly fewer trials than does the group which is required to perform more consecutive trials at criterion (Ausbel, 1965: Juola & Hergenham, 1967).

The third specific research question asks “do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to acquire the overhand throw as measured by the number of trials required to reach a pre-established criterion?” With respect to the results of this analysis, it appears that those individuals who were nondisabled significantly outperformed those participants with mild mental retardation in terms of the acquisition of the overhand throw. These differences were present regardless of the number of consecutive throws (i.e., two versus four) required at the pre-established criterion. This finding reflects the results in the published literature (e.g., Roberton & DiRocco, 1981), which indicate that individuals with mental retardation exhibit delays when compared to their nondisabled peers in terms of the acquisition of motor skills.

The finding evidenced in this comparison has implications with respect to the physical education practitioner. As previously mentioned, there is an increasing trend toward the inclusion of students with disabilities into regular education environments
with their nondisabled peers. Because of this trend, practitioners require pedagogical strategies, or "best practices", which will allow them to provide the most appropriate learning environment for all students. The above finding that students who are nondisabled require significantly fewer trials to acquire the overhand throw than do those students with mild mental retardation provides insight for the physical educator. This knowledge tells the practitioner that when setting up inclusive learning settings designed with skill acquisition in mind, the learner with mental retardation must be provided with additional opportunities or instructional aides (i.e., peer tutors, physical education homework) in order to allow equitable amounts of skill acquisition between groups of students to occur.

The fourth specific research question asked "do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?" In terms of the effect of varying levels of overlearning, it was found that a statistically significant difference did not exist on follow-up retention testing for the subjects with mild mental retardation. In other words, participants who engaged in greater levels of overlearning during acquisition did not outperform those participants who engaged in lower levels of overlearning. This result differs from many studies for individuals with mental retardation (Chasey, 1971; Chasey & Knowles, 1973; Chasey, 1977; Morehouse, 1988) in that a great deal of the published literature in this area has illustrated the positive effect of overlearning during acquisition on retention of motor
skills. However, despite the lack of statistical significance with respect to this finding, it is important to note that those participants who were asked to complete four consecutive trials during acquisition were able to display retention of the skill during follow-up testing in fewer trials than the groups who were asked to complete the task two consecutive times during acquisition. Participants in Group 2 (4TTC/MR) required, on average, 53.26 trials during follow-up testing, while participants from Group 1 (2TTC/MR) exhibited a mean score of 57.04 trials to achieve the follow-up testing criterion. As such, despite the lack of statistical significance for the different levels of overlearning during retention, it appears that those individuals who were required to complete four consecutive trials at the pre-established criterion during acquisition were able to achieve the criterion in fewer trials following a three-week retention interval than those participants who were asked to complete two consecutive trials at criterion during acquisition.

This finding has practical implications for the practitioner working with students with mental retardation in the physical education setting. According to the statistical analysis (i.e., the ANOVA), it does not appear that providing additional trials during initial acquisition will help to facilitate significant retention of gross motor skills over a long period of time. The impact on the practitioner is that when providing skill instruction, according to these results, allowing for additional opportunity to practice the skill during acquisition will not significantly affect long term retention of the skill, and this time may be spent working on other areas of psychomotor development. Further analysis of the data, however (i.e., effect size calculation, comparison of “savings score”
for group who engaged in additional overlearning), indicate that additional trials during acquisition may have in fact positively impacted the ability to retain the overhand throw for individuals with mental retardation. Based on this finding, despite the fact that statistical significance was not achieved, it appears that physical education practitioners would be well served by allowing students the opportunity to overlearn motor tasks well past initial acquisition, so that long-term retention of the skill may be attained.

The fifth specific research question asked “do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?” As was evidenced through the analysis of the data for individuals with mild mental retardation, it was found that a statistically significant difference did not exist on follow-up retention testing for those participants who were nondisabled. This result differs from many studies for individuals who are nondisabled (Ausbel, 1965; Schendel & Hagman, 1982) in that a number of studies indicate the positive effect which overlearning during initial acquisition has on the retention of motor skills. However, as was the case for participants with mental retardation, those individuals who were nondisabled that engaged in greater levels of overlearning during acquisition (i.e., four consecutive trials at criterion) were able to display retention of the skill during follow-up testing in fewer trials than the groups who were asked to complete the task two consecutive times during acquisition. As such, despite the lack of statistical significance for the different levels of overlearning during retention, it appears that those individuals who were required to complete four
consecutive trials at the pre-established criterion during retention were able to achieve the criterion in fewer trials following a three-week retention interval than those participants who were asked to complete two consecutive trials at criterion during acquisition. This result, combined with the knowledge that the large effect size value which was present accounted for a considerable amount of variance, indicates that despite the lack of a significant ANOVA result, differences between the groups existed. From the vantage point of the physical education practitioner, the practical applications of this finding mirror those for working with students with mental retardation in that the provision of additional opportunities to practice the skill past the point of initial acquisition will likely lead to greater long-term retention of the skill.

The sixth specific research question asked “do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to retain the overhand throw, as measured by the number of trials required to reach a pre-established criterion?” Based on the analysis of the data, it appears that those participants who were nondisabled significantly outperformed their peers with mild mental retardation in terms of retention of the overhand throw following a three-week retention interval. This finding was present regardless of the number of consecutive trials required of the participant (i.e., two or four) at the pre-established criterion. This result mirrors several previous studies (Lance, 1965; Morehouse, 1988), although previous research has shown that individuals with mental retardation and their nondisabled peers did not differ with respect to their retention of a gross motor task following a retention interval (Audie, 1981; Cantor & Ryan, 1962).
One possible explanation for the difference in retention between individuals with mild mental retardation and those who were nondisabled may have had to do with the complexity of the task and the ability to utilize various central nervous system processes to recall all of the components after a three-week retention period. Many previous studies examining the effect of varying levels of overlearning on retention have focused on tasks such as pursuit rotor tracking tasks (Parker & Fleishman, 1962) or stabilometer balancing tasks (Melnick, 1971; Scott, 1971), which do not involve the degree of sequential coordination of separate task components that an activity such as the overhand throw does. As such, it may be possible that for those participants with mental retardation, because of their delays in terms of central nervous system processes such as information storage and retrieval, that the complexity of the task combined with no feedback being provided during retention testing may have resulted in a greater number of trials being required than for those subjects who were nondisabled.

The finding that individuals with mental retardation required significantly more trials to exhibit retention performance of the overhand throw has direct implication for physical education practitioners who work with students with mental retardation. This result indicates that students with mental retardation must be provided with additional time and direct instruction in order to best facilitate long-term retention of gross motor skills. As was mentioned when discussing the results of the acquisition data, the physical education teacher must, through the use of various pedagogical strategies (e.g., one-on-one instruction, use of peer tutors or aides, giving physical education homework in the form of practicing the task out of the class setting), provide the student with mental
retardation greater periods of time to recall skills previously learned in order that the integration with nondisabled peers be successful.
CHAPTER 5
SUMMARY. CONCLUSIONS AND RECOMMENDATIONS

This chapter addresses the study as a whole. More specifically, this chapter provides a summary of the study, along with conclusions that have been drawn, as well as providing recommendations for future research in the area.

Summary

The concept of overlearning involves a procedure where an individual continues practicing a skill after having achieved success (Schmidt, 1988). Overlearning appears to be the variable which plays the greatest role in terms of the retention of information (Llewelyn, 1974). Previous research focusing on the role of overlearning with respect to the retention of motor skills for individuals with mental retardation indicates that, as is the case with nondisabled individuals, overlearning is beneficial to retaining motor skills (Audie, 1981; Chasey, 1971; Chasey & Knowles, 1973; Morehouse, 1988; Scott, 1971).

More recent literature (Morehouse, 1988) examining the role of overlearning on skill retention for individuals with disabilities has focused on the use of a concept known as trials-to-criterion (TTC). The TTC method involves engaging in sequential trials of a task until a pre-specified number of successes are obtained by the subject (Chow, 1991). The TTC method appears to be appropriate when working with subjects with disabilities
in order to address concerns raised in the literature concerning the lack of discriminatory power observed with instruments that task analyze gross motor skills (Bridges, 1992). The TTC technique allows individuals to perform until they have achieved success, provides more opportunity for practice, and results in a better estimate of the lesser skilled performers' ability (Sorenson, Hooper & Spray, 1982).

The enactment of federal legislation (e.g., Public Law 101-476, Public Law 101-336), combined with a philosophical shift in society has led to an increasing trend toward the inclusion of individuals with disabilities into full-time, regular education placement (Downs & Williams, 1994). This trend has led to a circumstance where more physical education practitioners will likely have a student with a disability placed into their classroom. As such, it is important to provide practitioners in the field with information concerning how students with disabilities, and their nondisabled peers, acquire and retain motor skills in an applied manner. To date there is little empirical data in the published literature examining the use of overlearning on the retention of a motor task for individuals with mild mental retardation when compared to their nondisabled peers.

The purpose of this study was to examine the effect which varying numbers of consecutive trials (two versus four consecutive trials) during acquisition would have on the retention of the overhand throw for children ages four to seven with mild mental retardation. Additionally, the study also examined if differences existed between subjects with mild mental retardation and their nondisabled peers with respect to the acquisition and retention of the overhand throw. The study addressed six research questions, which are as follows:
1. Do varying numbers of consecutive trials required at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?

2. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) differ in terms of the effect on the acquisition of the overhand throw, as measured by the number of trials required to reach the criterion, for students who are nondisabled?

3. Do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to acquire the overhand throw as measured by the number of trials required to reach a pre-established criterion?

4. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students with mild mental retardation?

5. Do varying numbers of consecutive trials required of the subject at a pre-established criterion (two versus four) during acquisition differ in terms of the retention of the overhand throw, as measured by the number of trials required to achieve the criterion, for students who are nondisabled?

6. Do differences exist between students with mild mental retardation and students who are nondisabled in terms of their ability to retain the overhand throw, as measured by the number of trials required to reach a pre-established criterion?
A review of the literature provides evidence that overlearning during the initial stages of learning is an important feature with respect to long-term retention of motor skills. However, it appears that there is concern with respect to the lack of applied research concerning the effect of overlearning on real world types of tasks (e.g., throwing), as well as a significant lack of recent research dealing with overlearning (Driskell et al., 1992). The need for further research in the area of overlearning and its impact on skill acquisition and retention for individuals with mental retardation becomes even more apparent upon examination of the literature dealing with inclusion and physical education. There has been a trend in recent years toward the full inclusion of students with disabilities into the regular education setting. This trend has spawned an increase in the amount of literature which has been published focusing on inclusive physical education. While more recent work has provided empirical data concerning different variables relating to inclusion, much of the literature in existence has simply focused upon philosophical statements and opinion pieces. Numerous authors (e.g., Blinde & McCallister, 1988) have noted the need for applied research to be conducted concerning the variables associated with the inclusion of students with disabilities. Such research will provide information for physical education practitioners, as it will begin to provide these individuals with "best practice" strategies which can be implemented when working in inclusive physical education settings. This, combined with the previously stated need for applied overlearning research, provides the basis for the current study.

Participants for the study were recruited from two school districts in the state of Louisiana, and were screened to equate initial performance on the overhand throw.
Following screening, participants were randomly assigned to one of four treatment groups: two consecutive trials-to-criterion, mild mental retardation; four consecutive trials-to-criterion, mild mental retardation, two consecutive trials-to-criterion, nondisabled; and, four consecutive trials-to-criterion, nondisabled. The participants were then asked to practice the overhand throw until they were able to achieve the pre-established criterion (displaying all four components of the Test of Gross Motor Development (TGMD) overhand throw task analysis) for their respective group. The dependent variable for this study was the number of throws required, both during acquisition and retention, for individuals to achieve a pre-established criterion for the overhand throw over a given number of trials (two consecutive throws or four consecutive throws, depending upon treatment group). A three-week retention interval followed the initial acquisition phase, at the end of which participants were asked to complete three consecutive trials of the overhand throw at criterion. Upon completion of three consecutive trials, the participation of the individual was complete.

The data analysis procedure which was utilized in the study was a simple analysis of variance (ANOVA), with a pre-established alpha level to determine statistical significance being established at .05. Two separate ANOVA's were conducted for this study; one to examine the data which were collected during the acquisition of the overhand throw, with the second ANOVA being utilized to examine the retention data. The dependent measure for this study was the number of trials required for the participant to reach the pre-established criterion both during acquisition and retention. In addition to the ANOVA, effect size was calculated for both acquisition and retention data. Data were
also collected in order to establish procedural integrity, interrater reliability and intrarater reliability.

With respect to the acquisition of the overhand throw, the results from the ANOVA conducted on the data indicate that those individuals who were nondisabled were able to acquire the task in significantly fewer trials than those participants with mild mental retardation, regardless of the number of consecutive throws required to achieve the pre-established criterion (i.e., two versus four). When examining participants of similar functional ability levels, it was found that for those participants who were nondisabled, the group requiring participants to complete two consecutive trials at criterion acquired the skill in significantly fewer throws than individuals who were asked to complete four consecutive trials at criterion during acquisition. For those students with mild mental retardation, however, a statistically significant difference was not found between participants requiring two consecutive trials at criterion versus those who were asked to complete four consecutive trials. Despite the lack of statistical significance, however, further examination of the data indicate that the difference between the groups approached significance, with those participants in the two consecutive trials group requiring less trials during acquisition than those individuals in the four consecutive trials group. In addition, the effect size analysis indicated that a large effect was in fact present for the acquisition data, indicating that differences between groups were in fact present.

In terms of the data analysis which was conducted for the follow-up retention test, it appears that, as was the case during initial acquisition, participants who were nondisabled required significantly fewer trials to achieve the pre-established criterion.
(three consecutive trials at criterion) than did those individuals with mild mental retardation, regardless of the number of consecutive trials which were required of subjects (i.e., two versus four) during initial acquisition. With respect to varying levels of overlearning during acquisition on retention of the throw, investigation of the data indicated that a statistically significant difference did not exist between groups for subjects with mild mental retardation or for those participants who were nondisabled. Further examination of the data, however, indicate that overlearning during acquisition may, in fact, have helped to facilitate retention of the throw. For participants of both levels of functional ability (i.e., nondisabled and mild mental retardation), the groups who were required to complete four consecutive trials at criterion during acquisition took less trials to achieve criterion during follow-up retention testing than did those individuals who were asked to complete two consecutive trials during acquisition. Further, investigation of the differences in mean scores between acquisition and retention indicate that participants in the four consecutive trials groups had a larger decrease in the number of trials required during retention than did those individuals in the two consecutive trials groups. As such, despite the lack of statistical significance found between groups during retention testing, the improvement of those participants who were asked to complete four consecutive trials during acquisition indicates that, in fact, overlearning of the overhand throw may have aided in retention.
Conclusions

The results of this study provide further insight into how to best facilitate motor skill acquisition and retention for students with and without disabilities in the physical education domain. The analysis of the data from the study supports previous findings in the published literature which conclude that individuals with mental retardation require significantly longer periods of time both to acquire and retain motor skills when compared to individuals who are nondisabled (e.g., Morehouse, 1988; Roberton & DiRocco, 1981; Scott, 1971).

With respect to the effect which overlearning during acquisition had on the retention of the overhand throw, the differences between treatment groups in this study was not statistically significant for both individuals with mild mental retardation or for subjects who were nondisabled. As such, a definitive conclusion cannot be made with respect to overlearning aiding in the facilitation of retention of the overhand throw. However, further inspection of the data indicates that those participants, both nondisabled and those with mild mental retardation, who engaged in additional overlearning during acquisition, showed greater gains as measured by the difference in number of trials required from acquisition to retention, than did those individuals in groups undergoing lesser levels of overlearning during acquisition. Additionally, the fact that a large effect size was present provides evidence that overlearning during acquisition did in fact have a positive effect on retention. The fact that statistical significance was not achieved for the retention data may possibly be explained by the large degree of variability of performance for those participants with mild mental retardation.
The finding that participants undergoing greater levels of overlearning during acquisition required fewer trials to reach the retention criterion has implications for the physical education practitioner. The idea that overlearning during initial skill acquisition may lead to a "savings" in terms of the amount of time required for the individual with mild mental retardation to recall a motor skill provides insight with respect to how best to structure the learning environment in physical education. It is well established that individuals, both with and without disabilities, require basic prerequisite motor skills before they can move onto more complex (i.e., sport or activity specific) tasks. If the individual with mental retardation does not acquire, and retain, the appropriate precursor motor tasks, than further psychomotor skill development will be severely inhibited. As such, results such as these which provide evidence as to the effectiveness of overlearning on skill retention provide physical education professionals with strategies to best facilitate learning for students with mental retardation. Research into the skill acquisition characteristics of individuals with disabilities becomes of increasing importance as the trend toward the inclusion of individuals with disabilities into the regular school setting continues, as teacher preparation programs must strive to provide "best practice" strategies to future practitioners who will work directly with students with disabilities in the inclusive physical education setting.

Many of the previous studies have investigated the effect of overlearning on retention as it relates to tasks which may not be of a particularly functional nature to the physical education practitioner (i.e., pursuit rotor tasks, linear tracking tasks), while the current study has attempted to address the issue of overlearning as it applies to a
commonly used gross motor task in the physical activity domain. Based on the analysis of the data collected during the study, a greater understanding as to how individuals with disabilities attain and retain applied, practical motor skills has been acquired.

Recommendations

As the trend toward the full inclusion of individuals with disabilities into all aspects of society continues to evolve, it is vital that a greater understanding is acquired in terms of how best to facilitate the normalization process. One of the avenues through which this process can be enhanced is through scholarly research inquiry, which provides answers and allows us to make conclusions as to the most effective instructional strategies to use when working with individuals with disabilities. In a field that focuses on the physical activity domain, this line of inquiry is of paramount importance, in that many professionals currently employed in the field have a very limited knowledge of the psychomotor needs of persons with disabilities. Despite this, they are being asked to provide quality physical activity programs for individuals with disabilities both in the public school setting, as well as in the private sector. As such, the need for a greater understanding of how to best facilitate skill acquisition and retention for individuals with disabilities is crucial in order that this information can be passed along to practitioners who work to provide programs for these individuals.

The current study has attempted to further the line of inquiry in this area by investigating the impact which overlearning during acquisition has on the retention of the
overhand throw for individuals with mild mental retardation. To continue this particular line of inquiry, the following research is recommended:

1. A similar study should be conducted in which there is a greater separation between the number of trials-to-criterion for different groups (i.e., two versus five consecutive trials, two versus seven consecutive trials).

2. The present study focused primarily on quality of performance, rather than a specified end result (i.e., more points for hitting closer to the center of the target). A future study should focus on the relationship between movement quality and movement quantity (i.e., accuracy, force production).

3. Future study examining the effect of overlearning on additional functional psychomotor activities should be conducted (e.g., kicking, striking, sport-specific activities such as shooting a hockey puck).

4. Relatedly, future study should focus on the overlearning of tasks in a community-based environment, in order that greater understanding as to how to best facilitate transition can be examined (e.g., overlearning not just psychomotor components of a task such as bowling, but also the ancillary prerequisite skills necessary to participate independently in the community, such as independent transportation, handling finances, etc.).

5. Future study is recommended which examines the effect of overlearning on the retention of motor skills for individuals of different functional ability levels (i.e., more severe levels of mental retardation), as well as differing disabling conditions (e.g., individuals with learning disabilities, traumatic brain injuries).
6. Because of the great degree of variability which is often present among subjects with disabilities, further studies should incorporate the use of effect size to provide greater explanation to the data which have been collected, or perhaps the use of single-subject research designs may be warranted, which is an idea that has been postulated in the research literature (Bouffard, 1993).

7. Future studies should examine the extent to which the overlearning of motor skills in the research setting transfers into everyday use. For example, a future study in this area may focus on whether overlearning of the overhand throw in a research situation leads to the ability of the performer to generalize the skill into other settings (i.e., Little League participation).

8. Study should be conducted to examine the role which varying types of verbal feedback play on the acquisition and retention of motor skills.

9. Further research is necessary to examine the variables associated with facilitating the inclusion of students with disabilities into the regular physical education setting. As further contributions to the published literature in this area are evidenced, some definitive conclusions can hopefully begin to be drawn as to how best facilitate the inclusion of individuals with disabilities into everyday physical education and community physical activity and recreation programs. This level of understanding can only help to foster the likelihood that individuals with disabilities will be able to take full advantage of the opportunities provided to them in a normalized, independent and respectful fashion.
REFERENCES


APPENDIX A

BEHAVIORAL AND SOCIAL SCIENCES HUMAN SUBJECTS

REVIEW COMMITTEE

THE OHIO STATE UNIVERSITY APPROVAL FORM
ACTION OF THE INSTITUTIONAL REVIEW BOARD

With regard to the employment of human subjects in the proposed research protocol:

95B0206 THE EFFECT OF KNOWLEDGE OF PERFORMANCE AND TRIALS TO CRITERION ON THE ACQUISITION AND RETENTION OF THE OVERHAND THROW FOR CHILDREN WITH MILD MENTAL RETARDATION, Paul Jansma, Mike Gillespie, Physical Activity and Educational Services

THE BEHAVIORAL AND SOCIAL SCIENCES HUMAN SUBJECTS IRB HAS TAKEN THE FOLLOWING ACTION:

X APPROVED

____ DISAPPROVED

____ APPROVED WITH CONDITIONS*  ______ WAIVER OF WRITTEN CONSENT GRANTED

It is the responsibility of the principal investigator to retain a copy of each signed consent form for at least three (3) years beyond the termination of the subject’s participation in the proposed activity. Should the principal investigator leave the University, signed consent forms are to be transferred to the Human Subjects IRB for the required retention period. This application has been approved for the period of one year. You are reminded that you must promptly report any problems to the IRB, and that no procedural changes may be made without prior review and approval. You are also reminded that the identity of the research participants must be kept confidential.

Date: May 21, 1999

Signed: ____________________________

(Chairperson)

HS-025B (Rev. 2/94)
APPENDIX B

SCHOOL BOARD APPROVAL FORMS
Mike Gillespie  
Assistant Professor of Health and Physical Education  
Nicholls State University  
126 Shaver Gymnasium  
Thibodaux, LA 70310

Dear Mr. Gillespie:

I am pleased to inform you that the superintendent has given his approval for your research project in our school system. He has requested that I inform you of his decision and provide you with an appropriate release form to use for your project. Please note that you must secure a signed release form prior to any activity that you do in our system from the parents of each student that you include in this project. Additionally, as you conduct your study, I am requesting that all of your research efforts be coordinated through the Adapted Physical Education teachers in the Thibodaux area schools.

Finally, we are requesting a copy of the results of your study. We will maintain on file in my office for later reference. Good luck and I hope that this study goes well.

Sincerely,

Sammy Hebert  
Supervisor of Special Education

SH:jl

Attachment

cc: Malcolm M. Duplantis, Ph.D.  
Linda Dangerfield  
Thibodaux Area APE Teachers  
Special Education Curriculum Coordinators  
Guy Harvey, THS  
Ed Guillot, ETJH  
Ken Delcambre, WTJH  
Madeline Hebert, TES  
Wanda Shields, WSL  
Roland Toups, SCE
September 25, 1996

Mike Gillespie
126 Shaver Gymnasium
Nicholls State University
Thibodaux, LA 70301

Dear Mr. Gillespie:

I reviewed your research project and have contacted the following schools:

1. Acadian School
   1020 Saadi Street
   Houma, LA

2. Broadmoor School
   1010 Broadmoor Ave.
   Houma, LA

3. Elysian Fields School
   700 Hiberia Place
   Houma, LA

4. Honduras School
   810 Grand Caillou Road
   Houma, LA

5. Schriever School
   2052 West Main
   Schriever, LA

6. Southdown School
   400 St. Charles
   Houma, LA

These school administrators have agreed to assist you with your research project. The names of the students are on a printout in my office. Please contact the school administrators to start your research. This letter will serve as permission from the school system.

Respectfully,

Barry Hutchinson, Supervisor
Special Education Services

BH:kg
APPENDIX C

SAMPLE INFORMED CONSENT FORM
Lafourche Parish School Board
OFFICE OF SUPERINTENDENT
P. O. BOX 879
THIBODAUX, LOUISIANA 70302

PERMISSION FOR PHYSICAL PARTICIPATION
IN EDUCATIONAL RESEARCH PROJECT
WITH RELEASE OF INFORMATION

DATE: __________________________

I hereby authorize the Lafourche Parish School Board to release to Mr. Mike Gillespie, Assistant Professor of Health and Physical Education at Nicholls State University, medical, social, psychological and educational information from my child’s Special Education records. This information will be used for the purposes of educational research and my child will in no way be identified by name in the completed research paper. The purpose of this study is to examine differences between disabled students and their non-disabled peers in the acquisition and retention of the overhand throw. I understand that my child will participate in an activity that will require the throwing of a ball in an overhand manner. To my knowledge, my child does not have a medical condition that would prevent his/her participation in this research project.

This consent is valid for the length of the project and publication effort.

DATE: __________________________ SIGNED: __________________________
(Parent or Guardian)

Address

________________________

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APPENDIX D

TEST OF GROSS MOTOR DEVELOPMENT OVERHAND THROW

TASK ANALYSIS
SKILL: Overhand Throw

EQUIPMENT/CONDITIONS: A tennis ball, a wall, and 25 feet of clear space.

DIRECTIONS: Tell the student to throw the ball "hard" at the wall.

PERFORMANCE CRITERIA:
1. A downward arc of the throwing arm initiates the windup.
2. Rotation of hip and shoulder to a point where the nondominant side faces an imaginary target.
3. Weight is transferred by stepping with the foot opposite the throwing hand.
4. Follow-through beyond ball release diagonally across body toward side opposite throwing arm.

SKILL ILLUSTRATION
APPENDIX E

PROCEDURAL INTEGRITY CHECKLIST
Subject Name: ________________________________

Date/Location of Session: ______________________

(Circle either yes or no for each of the following questions)

1. The subject is welcomed and provided with two warm-up throws before data collection begins.  
   Yes  No

   Comments: ___________________________________________________

2. The subject is handed the ball by the experimenter before each throw.  
   Yes  No

   Comments: ___________________________________________________

3. The subject is instructed by the experimenter to throw as hard as he/she can at the target.  
   Yes  No

   Comments: ___________________________________________________

4. The experimenter records the score for each throw immediately following every throw.  
   Yes  No

   Comments: ___________________________________________________

5. The subject is provided with both verbal and demonstrative feedback immediately following every throw (acquisition testing only).  
   Yes  No

   Comments: ___________________________________________________

6. The subject is thanked for participating at the end of the session, and told when his/her next session will be.  
   Yes  No

   Comments: ___________________________________________________
APPENDIX F

SAMPLE SCORESHEET
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