

AN ABSTRACT OF THE THESIS OF

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Title: The Effect of Trials-to-Criterion on the Retention of a Discrete Motor Skill by Moderately and Severely Mentally Retarded Individuals
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The purpose of the study was to investigate the effect of trials-to-criterion on the retention of a discrete motor skill (overhand beanbag throw) by moderately mentally retarded and severely mentally retarded individuals. Nonmentally retarded individuals were involved as a control group. The subjects were grouped by degree of retardation and randomly assigned to one of the three treatment groups: two, three, or four consecutive trials-to-criterion.

The task consisted of an overhand throw of a 2-inch square beanbag into the inner circle of a target from a distance of 10 feet. The subjects were provided one-to-one instruction until their respective criterion (2, 3, or 4 consecutive correct attempts) was met without assistance. The subjects were given up to eight weeks of instruction three times per week to meet criterion. A nationally validated systematic approach to instruction for the severely handicapped, as designed by Teaching Research and Oregon State University, was used.

The number of attempts it took each subject to achieve the learning criterion (2, 3, or 4 consecutive correct attempts) was recorded. All subjects began the retention interval once their respective learning criterion was met.

At the conclusion of the four-week retention interval the subjects were given a posttest to determine if the skill had been retained. Two consecutive correct attempts were used as criterion for the retention test. If the subjects did not meet the posttest criterion, one-to-one instruction was provided until two consecutive correct throws were achieved. The number of attempts it took each subject to reach two trials-to-criterion after the retention interval was utilized as a measure of retention.

A generalized, randomized block ANCOVA was used to determine if any significant difference existed between the experimental and control groups. The pretest served as the covariate and was used as the reference for comparison to the posttest.

The results of the study indicated that the scores of the mentally retarded subjects improved as a result of the treatment effect. Severely mentally retarded subjects who experienced three and four trials-to-criterion performed significantly better than severely mentally retarded subjects in the two trials-to-criterion group. No significant differences in the treatment groups were found for the nonmentally retarded and the moderately mentally retarded groups. However the moderately mentally retarded approached significance with better scores obtained by subjects in the three and four trials-to-criterion groups.

On the basis of the findings of this study and within the limitations of the investigation, it was concluded that increased trials-to-criterion significantly influenced the retention scores of severely retarded individuals.

THE EFFECT OF TRIALS-TO-CRITERION ON THE RETENTION OF
A DISCRETE MOTOR SKILL BY MODERATELY RETARDED
AND SEVERELY MENTALLY RETARDED INDIVIDUALS

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Dedication

This work is dedicated to my lovely wife, LaJean R. Lawson, who shares her feelings of goodwill and her joy of life with me and all those she touches.

Acknowledgments

This work symbolizes an individual commitment to personal and professional growth. However, it is the result of the collective commitment of many individuals. Thank you members of my committee, Dr. John M. Dunn, Dr. Gary H. Tiedeman, Dr. Tom E. Grigsby, Dr. Marie Boarman, and Dr. Vern Dickinson. Each of you contributed to this paper and to my professional growth in unique and special ways: Dr. John M. Dunn for his critical eye for detail, for his unrelenting commitment to excellence, for his command of the written word, for being one of my greatest mentors and kindly telling me to get off my duff; Dr. Gary H. Tiedeman for reinforcing the importance of my contribution and that I own my work; Dr. Tom E. Grigsby for instilling in me a commitment to life long learning and recognition that there may be more to learn in doing a dissertation than meets the eye; Dr. Marie Boarman for giving me support and, during those times of self denial, encouraging me to smell the roses; Dr. Vern Dickinson who gave me an opportunity to express my emotions regarding this experience and who always put me back on track.

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EFFECT OF TRIALS-TO-CRITERION ON THE RETENTION OF
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SEVERELY MENTALLY RETARDED INDIVIDUALS

CHAPTER I

INTRODUCTION

Research relevant to the way children retain material has received extensive review within educational and psychological literature. Retention is dependent upon several variables, including fewer competing responses, extensive practice, a total bodily effort, meaningfulness of the task, applicability of the skill to activities conducted at a later time, and whether or not the activity is enjoyable. Retention can also be dependent upon other practices, such as visual imagery, mental practice, overlearning, and the number of trials-to-criterion. One of the variables generally recognized as important in the retention of motor skills is overlearning (Audie, 1981; Burwitz, 1973; Llewelyn, 1974; Marquardt, 1977; Rarick, Dobbins, & Broadhead, 1976; Singer, 1980; Vergason, 1964). Overlearning is defined as the additional practice provided after a task has been learned according to some initial learning criterion. Increasing the initial learning criterion or the degree of overlearning may maximize the amount of information retained, lead to finer precision in motor control, or possibly diminish the effect of interference.

Shifflett (1985), in her review of trials-to-criterion (TTC), found that the performance of one correct time was the most consistent criterion

used with paired associates or lists of paired words. The literature in motor learning is inconsistent with respect to the recommended number of trials-to-criterion. Cuvo, Ellis, Wisotzek, Davis, Schilling, and Bechtal (1983) taught athletic skills to mentally retarded students, using two trials-to-criterion. Others (Alberto, Sharpton, & Stright, 1986; Csapo, 1981; Delmore, 1975) selected three TTC. In some cases four TTC were used with some success (Banks & Aveno, 1986). There appears to be little agreement on the criterion which has the greatest impact on retention of a gross motor skill performed by moderately or severely mentally retarded individuals.

A majority of the studies on trials-to-criterion, overlearning, and retention of motor skills has focused on non-mentally retarded individuals. It is well established that non-mentally retarded individuals retain motor skills, e.g., swimming, biking, and ice skating, over long periods of time, even with no practice. If a motor skill decrement does exist in a skill which was originally learned to criterion, the skill can be regained in a short period of time (Ammons, Farr, & Bloch, 1958; Battig, 1957; Melnick, 1971).

Only in the last two decades have investigators concerned themselves with the motor skill development and retention of mentally retarded individuals. While the relationship between overlearning and retention has been established for those individuals who are not mentally retarded (Melnick, 1971), little attention has been devoted to TTC and retention for mentally retarded subjects.

A problem exists in that very few attempts have been made to determine the effects of various levels of TTC on the retention of a discrete motor task by mentally retarded subjects. No attempts have been made to determine which level of TTC for mentally retarded students leads to the greatest retention. Delmore (1975) recommended that further research be

conducted to ascertain which level of TTC has the greatest impact on severely mentally retarded individuals.

Various levels of TTC have been utilized by Dunn, Morehouse, and Fredericks (1986) for the past several years with severely handicapped individuals. The TTC level chosen for these studies, as utilized in the Data Based Gymnasium, was justified from empirical data. Many questions exist regarding TTC and its application to an instructional system with moderately and severely retarded individuals. The present study originated from a search for answers to these perplexing problems. In order to apply the results directly to the classrooms, using the Data Based Gymnasium or similar systems, replication of the instructional process was considered essential. Snow (1974) referred to this replication as the representative design. Snow advocated the use of this design because it combats some of the basic problems with generalizing results, such as the application of a newly learned skill to a new environment (e.g., swimming in a pond after learning to swim in a pool).

The present study was designed to investigate the effect of various levels of trials-to-criterion on retention of a discrete gross motor skill by moderately and severely mentally retarded individuals.

Purpose of the Study

The purpose of the study was to investigate the effect of three levels of TTC (2, 3, and 4 consecutive correct trials) on the retention of a discrete motor skill (overhand beanbag throw) by 30 moderately and severely mentally retarded individuals. The results of the study are intended to assist professionals using instructional motor learning techniques similar to

those described by Dunn et al. (1986). Using a representative design, as suggested by Snow (1974), ensures that the conditions of the experiment are similar to those in the classroom and increases the ability to generalize the findings.

Need for the Study

Experimentation with the learning abilities of mentally retarded subjects received impetus during the early 1950s. Mentally retarded individuals were compared to nonhandicapped populations in performance of numerous learning tasks, primarily those involving verbal activities (e.g., labeling pictures, repeating word and letter lists, identifying codes and geometric forms) and performing fine motor tasks (e.g., picking up small objects, using scissors, and drawing) (Baumeister & Kellas, 1967; Baumeister, Smith, & Rose, 1965; Ellis, 1970; Horner, 1985; Lavery, 1964).

Unfortunately, little information has been presented to assist teachers in responding to the gross motor needs of students with moderate to severe mental, emotional, and sensory impairments. Since valid inferences cannot be made from the retention of verbal materials to the retention of movement activities, or from studies with non-mentally retarded populations to individuals who are mentally retarded, a need exists to expand the body of knowledge in the motor domain to special populations, including those who are moderately and severely mentally retarded.

Not only is there a dearth of research on retention, TTC for original learning, and TTC for overlearning related to individuals who are moderately and severely mentally retarded, there appear to be a number of contradictions in the information reported. In comparing individuals who are

mentally retarded to those who are not, no significant differences were found between the two groups on overlearning and the retention of tasks (Ammons et al., 1958; Cantor, 1960; Ellis, 1970; Lott, 1958; O'Connor & Hermelin, 1983). In contrast, significant differences on overlearning and retention between the two types of subjects were observed in studies conducted by Ellis, Pryer, and Barnett (1960), Heber, Prehm, Nardi, and Simpson (1967), and Lance (1965). Ellis et al. (1960) used a motor task to test retention by 80 institutionalized mentally retarded subjects and 80 public high school students. Retention was measured by a block of 10 trials after rest intervals of 1 and 28 days. The results indicated that non-mentally retarded subjects retained a larger percentage of motor/verbal information when compared to mentally retarded subjects.

More recently, Audie (1981), Chasey (1971), Chasey and Knowles (1973), Delmore (1975), and Lombardo (1977) reported the effects of gross motor skill overlearning on long term retention by individuals who are mentally retarded. Audie concluded that overlearning did not significantly affect the amount of retention of a balancing task with subjects who are moderately mentally retarded. Chasey and Knowles (1973), Delmore (1975), and Lombardo (1977) reported that overlearning did have a significant effect on the subjects' performances after various retention intervals.

Several studies have incorporated percentages of overlearning into their methodology. The percentages were applied to the number of trials it took to originally learn the motor task. For example, a subject in the 50% overlearning group, who required 100 trials to meet the original learning criterion, would have to complete 50 more trials (50% of the number of trials it took to reach the original learning criterion) in order to reach the overlearning level. This application of overlearning has been accepted as a

means to enhance the retention of motor skills for mentally retarded and non-mentally retarded subjects (Chasey, 1971; Chasey & Knowles, 1973; Delmore, 1975; Hebb, 1949; Lombardo, 1977; Smith, 1968). The above overlearning process has not been employed with severely mentally retarded subjects.

Using an alternative approach to overlearning, Audie (1981) set an original learning criterion of two consecutive trials. Overlearning percentage levels were set at 50%, 100%, and 150% and were applied to the original learning criterion. The overlearning criterion for the 50%, 100%, and 150% levels was, respectively, 3, 4, and 5 consecutive correct trials. This process of specifying a set number of trials as a means of determining levels of overlearning has not been used in a controlled motor learning environment with severely mentally retarded subjects. This approach appears promising because it is a manageable approach and consistent with the learning theory applied to this population. Using set criterion levels or trials-to-criterion for learning is practiced in many special education classrooms.

The investigation of gross motor experiences, i.e., skills which involve coordination of large muscles in activities, and the effect of TTC upon the retention of these skills by moderately and severely mentally retarded subjects has received relatively little attention from researchers. This study will investigate this neglected area. The clarification of the relationship between overlearning and retention of motor skills, as performed by severely mentally retarded subjects, may assist educators in maximizing the ability of these students to retain motor skills.

Statement of the Problem

The purpose of this study was to determine the effect of the number of trials-to-criterion on the retention of a discrete motor skill (overhand beanbag throw) by moderately and severely mentally retarded individuals.

Hypotheses

The results of the study were analyzed to determine if the following null hypotheses should be retained or rejected:

- Ho¹ There is no relationship between pre- and post-test scores.
- Ho² There is no treatment effect for the number of trials-to-criterion.
- Ho³ There is no effect for retardation.
- Ho⁴ There is no interaction effect between the number of trials-to-criterion and the level of retardation.

Limitations of the Study

This investigation was conducted under the following limitations:

- 1) Various skill levels existed within the randomly selected sample of moderately and severely mentally retarded subjects.
- 2) Previous involvement in physical education varied among the sample.

Delimitations

This study was delimited to 90 subjects who ranged in age from 9 to 20 years. Sixty of the subjects were classified as moderately or severely mentally retarded according to criteria established by the American Association on Mental Deficiency (Grossman, 1977). All of the mentally retarded subjects resided at the Fairview State Hospital in Salem, Oregon. Thirty non-mentally retarded subjects from Corvallis, Oregon, were included in the study to serve as a comparison group. All of the non-mentally retarded subjects attended a regular public school and lived at home.

None of the subjects possessed orthopedic or sensory impairments which would affect the results of their performance on the motor task used in this study. The instructional methodology used in the study followed the data based gymnasium system described in Dunn et al. (1986). The motor task employed in the study was an overhand beanbag throw. Subjects were taught the task using different levels of trials-to-criterion with a maximum instructional period of eight weeks.

Assumptions

For the proposed investigation, the following assumptions were recognized:

- 1) Subjects in this study were representative of the moderately and severely mentally retarded individuals residing in the Fairview Training Center and non-mentally retarded students from the public schools of Corvallis, Oregon.

- 2) Subjects did not rehearse the gross motor skill during the no practice interval.
- 3) The discrete motor skill is a novel activity with which subjects have had no prior experience.

Definition of Terms

The following definitions were used throughout the study:

<i>Attempt</i>	An attempt is one throw of the beanbag at the target by a subject.
<i>Ceiling Effect</i>	Ceiling effect occurs when the skill is too easy and the performer achieves the maximum score on the pretest, thereby negating the opportunity to improve performance on the posttest.
<i>Cue</i>	A cue is a sign, signal, request, or information that influences the occurrence of a behavior (Dunn et al., 1986).
<i>Discrete motor task</i>	A discrete motor task involves a skill with a fixed beginning or end and contains one trial. The skill used in this study was an overhand throw using a beanbag with 2-inch square dimensions. The task analysis of the throw can be found in Appendix A.
<i>Handicapped</i>	Public Law 94-142 defines individuals with handicaps as: "Those students evaluated as being mentally retarded, hard of hearing,

deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, deaf/blind, multihandicapped, or as having specific learning disabilities, who because of those impairments, need special education and related services" (Federal Register, 1977).

Learning

Learning is operationally defined as an improvement of performance scores from pretest to posttest results.

Mental Retardation

Mental retardation refers to: significantly subaverage general intellectual functioning (less than 70 IQ) existing concurrently with deficits in adaptive behavior and manifested during the developmental period (Eichstaedt, 1987).

Model

A model refers to the demonstration of a skill for the subjects. The model is one of the levels of assistance used during one-to-one instruction (Dunn et al., 1980).

Moderately Mentally Retarded

The expression moderately mentally retarded refers to those individuals who have a mental age of 2.9 years to 10.2 years, correctable visual acuity to 20/200, an IQ of 36-51, a chronological age of 8-20

years, and the absence of physical abnormalities which may influence the ability to execute the discrete motor task.

Motor Learning

A set of internal processes associated with practice or experience leading to relatively permanent changes in motor skills (Schmidt, 1982).

Non-mentally Retarded

The non-mentally retarded individuals included in this study range in age from 12-19 years, IQ ranging from 95-115, correctable visual acuity to 20/200, and the absence of any mental or orthopedic impairment.

Original Learning

Original learning is the number of trials established to meet the criterion of success. Once criterion has been met, the subject is taught the next phase and continues until the terminal objective has been accomplished.

Overlearning

Overlearning refers to practice provided on a task subsequent to having been learned according to some criterion, (Singer, 1980,).

Physical Assistance

When a subject fails to perform the skill appropriately, physical assistance is used to give the individual an opportunity to perform the skill correctly and to develop a sense of the correct movement pattern (Dunn et al., 1986).

- Prompt* A prompt is a verbal, gestural, or tactile cue and is used to remind the subject, when appropriate, of the correct motor response (Dunn et al., 1986).
- Retention* Retention is the extent of proficiency on a skill after a period without practice (Stallings, 1982). The retention interval of this study was 28 days.
- Severely Mentally Retarded* The severely mentally retarded individuals included in this study had a mental age of 2.1 years to 7 years, correctable visual acuity to 20/200, an IQ of 21-35, chronological age of 8-20 years, and the absence of physical abnormalities such as cerebral palsy or other orthopedic impairments which influence throwing capabilities.
- Trial* A trial is that phase of the instructional process which begins with the verbal cue and ends with the successful completion of the task with or without assistance.
- Trials-to-Criterion* Trials-to-criterion designates the number of consecutive times a skill must be performed to be considered as learned.

CHAPTER II

REVIEW OF LITERATURE

In Chapter One various degrees of overlearning and trials to original learning criterion were suggested as factors which influence retention. There appear to be distinct similarities and differences in the ability of mentally retarded individuals to retain motor skills. Mentally retarded individuals have been compared to non-mentally retarded individuals in an attempt to determine similarities and differences between the learning capacities of the two groups. Only in the last several years have investigators examined how moderately and severely mentally retarded individuals differ in their ability to learn and retain motor skills. A review of learning, overlearning, and their effect on the retention of motor skills will be presented in this chapter.

This review is divided into the following sections: short-term memory (STM) theories and their relationship to the sensory register and the rehearsal buffer; long-term store (LTS) and its relationship to interference, rehearsal, retrieval, and various retention intervals; and the effect of overlearning and trials-to-criterion (TTC) on retention over various intervals of time. The importance of the studies on various levels of TTC as they relate to the retention of motor skills by moderately and severely mentally retarded subjects will be shown.

Short-Term Memory

A common short-term memory (STM) experience occurs when an individual looks up a phone number, dials the number, and forgets the number dialed before the busy signal is heard. The sensory register selects the voice of the party rather than remembering the number since the expectation is to hear the party answer. This suggests that there is a STM and that information is rapidly lost when there is no sustained attention or rehearsal (Singer, 1980).

According to Loftus and Loftus (1975), forgetting begins in approximately 2 seconds and is virtually complete within 15 seconds. In the above example, it is likely the numbers were forgotten since no form of coding, imagery, or chunking was used. Use of one of these techniques indicates that a move from the sensory register to STM has taken place. If the number dialed has some significance or meaning and was rehearsed, it has a greater chance of being retained.

Rehearsal is the technique utilized by the individual for the purpose of remembering. Mentally retarded individuals do not attend spontaneously to situations which call for rehearsal (Robinson, 1976). Therefore, they lose much of the information they are capable of remembering. Mentally retarded individuals, however, can be trained to use rehearsal techniques. Frank & Rabinovitch (1974) stated that spontaneous rehearsal is clearly evidenced by nonhandicapped students as early as the third grade. For many moderately and severely handicapped individuals, spontaneous rehearsal may never be achieved unless they have been specifically trained to use rehearsal. Riegel and Taylor (1974) suggested that mentally retarded children who can

organize or be trained to organize input at a conceptual level can rehearse, cluster, and consequently recall more during output.

Kelso (1979) allowed non-mentally retarded subjects to preselect and voluntarily rehearse their own arm movements, in addition to performing constrained, experimenter-defined movements at three retention intervals (0, 7, and 15 seconds). Performance was maintained for both types of arm movements over 7 seconds, but deteriorated within 15 seconds. An interpolated motor task designed to block rehearsal processes did interfere with reproduction at 7 and 15 second retention intervals. These findings suggest that mildly retarded children could maintain motor function information over brief time periods and also illustrate the important contribution of the planning component in facilitating the coding of motoric information.

Posner (1967), and later Laabs (1973), suggested that memory for terminal limb position involves a visual code that can be rehearsed and that interference occurs when rehearsal opportunities are blocked. Kelso, Goodman, Stamm, and Hayes (1979) suggested that mentally retarded children are capable of this type of representational activity for at least a short period of time and demonstrate rehearsal deficits in verbal STM (Brown, Campione, & Murphy, 1974; Flavell, 1970).

The inability to attend to verbal and perceptual feedback suggests another possible explanation for inferior reproduction of motor responses (Hermelin & O'Connor, 1975). The motor performance of mentally retarded individuals is typically inferior to non-mentally retarded individuals (Francis & Rarick, 1959; Rarick, Dobbins, & Broadhead, 1976; Rarick, Widdop & Broadhead 1970). One of the reasons suggested for the markedly inferior performance on motor tasks is a short term memory deficit among mentally retarded individuals. The literature suggests that this inferiority is the

result of inadequate spontaneous rehearsal strategies, such as mnemonic devices rather than a faulty storage mechanism (Brown et al., 1974; Ellis, 1970; Reid, 1980).

Ellis (1970) found that mentally retarded individuals do not actively rehearse information. When rehearsal was controlled, mentally retarded subjects improve their ability to recall information by 20 to 30 percent. Belmont and Butterfield (1971) compared the ability of mentally retarded and non-mentally retarded to use active rehearsal strategies. They found that mentally retarded individuals do not use active rehearsal strategies and their lack of distinctive pauses during rehearsal contributed to their lack of STM. When subjects were forced to rehearse, the results indicated enhanced STM for mentally retarded subjects and greatly decreased STM for non-mentally retarded subjects. This study may suggest a reasonable means for mitigating STM deficiencies.

Anders (1971) found that filling the retention interval with rehearsal preventing activity had a far more detrimental effect upon the STM of intellectually average individuals than on STM of mentally retarded subjects. The non-retarded subjects lost information at a faster rate under the filled retention interval than the unfilled. The same was not true for mentally retarded subjects. Anders (1971) believes this to be due to a deficiency in the use of rehearsal strategies by mentally retarded subjects. The interference strategies did not impact the scores of the mentally retarded subjects because rehearsal strategies were not in use. Learned information must be systematically presented to mentally retarded subjects in an attempt to establish a higher degree of organization of the stored information. This may offset their low probability of attending to the relevant cues of the learned material (Zeaman & House, 1963). When mentally retarded individuals do

not attend to the appropriate information, the stored data are poorly organized and may influence the degree of retrieval.

Moss and Sharac (1970) have shown that STM performance depends on the rate at which the stimuli are presented. The slower presentation rates permit more rehearsal than fast presentation rates. Mentally retarded subjects who exhibit equally poor STM under either fast or slow presentation either must not be rehearsing even when given more time or are not attending to the significant stimuli. Ellis (1970) concluded that the deficiency of mentally retarded subjects in recall accuracy translates into a rehearsal deficiency. He explained that the deficiency arises through a failure to generate an appropriate information intake strategy by not systematically increasing attending behaviors as stimuli are presented.

Winters and Gerjouw (1971) suggested that mentally retarded subjects do not rehearse material as well due to their inability to attend to a task. The approach of the mentally retarded to attending is less patterned and less methodically sequential.

Spitz and Webreck (1971) hypothesize that an image presented on a screen will, after its removal, remain longer with mentally retarded subjects. This may influence the subjects' capacity for registration of sensory input and the rehearsal of such input.

Original investigations of STM, such as that of Postman (1963), involve one trial learning. This idea has often been criticized by those who question whether actual learning can occur during one trial. Transfer from STM to long-term memory (LTM) is probably aided by additional learning trials and reinforcements. Training does not always result in an effective

gain when one trial is used. The skills learned under such conditions dissipate rather rapidly with time. Brown et al. (1974) found that this deficit could be overcome by increasing the number of trials.

Three TTC have been successfully used as the learning criterion by researchers working with moderately and severely mentally retarded subjects on fine and gross motor skills, daily living skills, and vocational assembly skills (Alberto, et al., 1986; Chasey & Knowles, 1973; Hunt, Goetz, Alwell, & Sailor, 1986; Kayser, Billingsley, & Neel, 1986; Schleien & Larson, 1986).

Long-Term Memory

Long-term memory, which is determined by responses measured after hours, days, months, or years, appears to cause less problems for mentally retarded subjects as long as the patterns of responses are reinforced (Smith, 1968). The type of material learned, the methods utilized in original learning and training, the length of the retention interval, and the measurement method utilized to determine retention influence the reported results of various investigations. These procedural variables are discussed in the following section.

Spontaneous Trace Decay

The concept of Spontaneous Trace Decay introduces the question of whether forgetting results from the passage of time, or whether forgetting is due primarily to interference from other memory traces in an increasingly crowded long term memory store (Ceraso, 1967).

Plato was one of the earliest proponents of the Spontaneous Trace Decay theory of forgetting. Plato likened the initial formation of a memory

trace to the fresh imprint of a seal on a block of wax. Wax gradually loses its shape over time, and no imprint on its surface can remain clear indefinitely. Generally, there is a loss of sharp detail, then a complete fading of the entire pattern beyond recognition. The life of the imprints can be extended by cutting the initial trace as deeply as possible, or by periodically restamping the image whenever it starts to fade.

Plato's theory on Spontaneous Trace Decay was not widely accepted until Thorndike (1913) revitalized it through his laws of effect and exercise. Thorndike felt that learned behaviors would be maintained as long as they were practiced over time and followed by pleasurable consequences. A short time later Jenkins and Dallenbach (1924), using their sleep study, gave support to the concept that passive decay was not a cause of forgetting and found that the experimental group's retention score was significantly lower. It was concluded that interference from new experience, not time decay, was the primary cause of forgetting. The Jenkins and Dallenbach study has been replicated many times with similar results (Barret & Ekstrand, 1972; Dillon, 1970; Ekstrand, 1967). As a result of these studies the concept of spontaneous decay has lost support in favor of interference theory.

Interference

McGeoch (1939) introduced modern interference theory and argued that forgetting is not caused by the passage of time but rather it is due to competition or interference from other memory traces. Interfering items are recalled in place of the desired ones. The learning of new skills causes an "unlearning" of the old material (Melton & Irwin, 1940). As the number of

practice trials is increased, the occurrence of competing responses decreases. Even though competition diminishes, the desired response often remains unavailable.

Ceraso (1967) who likened interference to neither the "blocked channel" of McGeoch (1939) nor the "fading canvas" of Melton and Irwin (1940), perceived interference as causing an "unsuccessful hunt" for the desired item. The effort of new learning is to clutter an already overcrowded memory store. The more similar the skills, the broader the search must be and the less accessible some of the items will become.

Rehearsal

Rehearsal plays a major role in the maintenance of information in STM and its transfer to LTM. Rehearsal can be practiced in many ways, i.e., through verbally repeating the thought, actively imagining completing the skill, sequencing activities, the use of mnemonics, and through putting information into meaningful groups or organized chunks (Frank & Rabinovitch, 1974). The research indicates that mentally retarded individuals do not spontaneously tend to rehearse unless they are trained in its use and actively prompted to rehearse (Brown et al., 1974). This may indicate that the problem lies more in the employment of a control process rather than some structural impairment.

The higher the degree of initial organization during rehearsal, the greater the rate of retrieval. Lack of attending to appropriate information causes the stored information to be poorly organized, which in turn influences the degree of retrieval. Mentally retarded subjects enter a situation with a low probability of attending to the relevant dimensions and learn slowly which dimension is, in fact, relevant (Zeaman & House, 1963).

Retention

Previous research dealing with retention of verbal materials and fine motor skills has tended to vary in the selection of long term retention intervals. Most research had variations of one week and one month, two weeks, one month and six months, and one to two years (Kaufman, 1971; McLaughlin & Stephens, 1972).

Several studies dealing with overlearning and retention of gross motor skills (Audie, 1981; Chasey, 1971; Delmore, 1975; Melnick, 1971; Scott, 1971), used time intervals ranging from 7 to 42 days to test retention levels. The results of these investigations indicated that there were no significant mean differences in scores achieved at these various time intervals.

Ellis, Pryer, and Barnett (1960), found that a significant loss in performance occurred after 28 and 70 days of no practice. The experimenters suggested that if a loss occurred, it would occur within 28 days. There were no significant mean differences in retention scores between 28 and 70 days of no practice.

Overlearning

Much of the research on learning has dealt with comparisons of retention of verbal or fine motor tasks between retarded and nonretarded subjects. Retention of a skill is one factor used in determining if the skill has been learned. As discussed above, retention levels may be influenced positively or negatively by many factors. These include the length of time of the no practice interval between initial learning and the period of recall or retesting, the level of proficiency in performance reached during initial

learning, the amount of overlearning, the knowledge of results during recall, the organization of skill level performance or the complexity of the tasks, and the amount of overlearning levels reached after initial learning has taken place.

How much practice is necessary for the greatest amount of retention? This is a question often asked by physical educators, coaches, and adapted physical education teachers. The amount of initial practice is directly related to the amount retained. Overlearning refers to the practice provided on a task after it has been learned according to some criterion (Audie, 1981; Chasey, 1971; Delmore, 1975; Kaufman, 1971; Singer, 1980; Vergason, 1964). Studies concerned with overlearning report that increased practice beyond the learning criterion results in better retention performances.

The effect of overlearning on retention has been studied by psychologists since the 19th century. Few studies have focused on the relationship between motor skills, overlearning, retention, and mental retardation. Non-mentally retarded subjects were used in the majority of the research projects on overlearning until the 1950s.

Several investigators have indicated that overlearning is a major factor in the retention of motor skills by mentally retarded individuals (Ammons et al., 1958; Chasey, 1971; Chasey & Knowles, 1973, Chasey, 1977; Delmore, 1975; Ellis, Pryer, and Barnett, 1960; Simonsen, 1975). In many classrooms, skills are overlearned in order to insure adequate retention over varying periods of time, often without scientific evidence to support teaching methods or levels of overlearning. Krueger (1929) required nonhandicapped subjects to memorize nonsense syllables. He found that the optimum level of overlearning for maximum retention was 50%. Increasing the amount of overlearning beyond the level of 50% was relatively less beneficial. A year

later, Krueger failed to replicate his results when studying the effect of overlearning on a perceptual motor task. However, several studies have supported Krueger's original finding that 50% overlearning is the optimum amount for mentally retarded individuals (Burwitz, 1972; Chasey, 1971; Chasey & Knowles, 1973; Perry, 1978).

The results of several other studies have varied from those just cited. Audie (1981), Cantor and Ryan (1962), Ellis et al. (1960), Hammer-ton (1963), Lott (1958), and O'Conner & Hermelin (1963) found no significant difference when comparing the effects of overlearning on mentally retarded and non-mentally retarded subjects. In contrast, Delmore (1975), Heber et al.,(1962), Lance (1965), and Melnick (1971) found a significant difference in the amount of retention between non-mentally retarded and mentally retarded subjects with overlearning. Only a few of the preceding studies used a motor task (Audie, 1981; Delmore, 1975; Ellis et al. 1960).

Hebb (1949) has stated that with continuous utilization of a pattern of response, the ability to generalize a response will increase. This is of particular importance to the mentally retarded individual. Reducing inappropriate random responses can be accomplished through overlearning (Smith, 1968). In addition, materials and tasks which are sequentially presented aid in the retention of the task (Spicker, 1966). Indeed, sequential presentation of material is an instructional process often used with mentally retarded subjects.

Melnick (1971) conducted one of the few investigations on overlearning using balancing on a stabilometer as the motor task. Eighty male college subjects received 0, 50, 100, or 200 percent overlearning. Retention tests were given one week and one month later and absolute retention (immediate recall) was measured on the basis of the subject's score on the first reten-

based upon the rate of trials taken for initial mastery, and trials taken on the retention test to reach the original learning criterion. The absolute retention measure showed retention intervals to be favored by overlearning.

Melnick (1971) recommended that studies investigating the effect of different amounts of practice on retention, allowing all subjects to either receive the same number of daily exposures to the testing situation or warmup trials, be given prior to retention testing. In addition, it was suggested that the speed of learning be investigated as an experimental parameter in determining its relationship to overlearning and retention.

Scott (1971) evaluated the differences between special classes of educable mentally retarded and non-mentally retarded children in their ability to acquire, retain, and relearn a gross motor skill. Thirty-six mentally retarded subjects with an IQ range of 53-79 and a chronological age between 5 and 13 years were studied. In addition, 36 non-mentally retarded subjects with an IQ range of 81-132 and chronological ages between 6 and 13 years were studied. The gross motor task was balancing on a stabilometer with the time recorded as the best score for each of the 16 trials during original learning. Each group of 36 mentally retarded and non-mentally retarded subjects was divided into two subgroups. Half of the subjects received the 16 original learning trials and the other half, after reaching criterion, were exposed to an additional 8 trials or 50% overlearning. The retention interval for all 4 groups was 1 month (28 days).

The results indicated that the educable mentally retarded subjects acquired the skill at the same rate as the non-mentally retarded subjects, but produced overall lower levels of performance. All 4 groups experienced some degree of forgetting after the 28-day retention interval. The educable mentally retarded did not differ significantly from the non-mentally retarded

mentally retarded did not differ significantly from the non-mentally retarded subjects in their ability to retain the skill. Fifty percent additional learning did not affect the retention of the skill, but the non-mentally retarded subjects did perform at a higher level and at a faster rate than the mentally retarded subjects. The relationship between IQ and performance on the stabilometer was stronger in the mentally retarded subjects.

Scott recommended that attention be given to the problem of determining when an individual reaches asymptote, so that all individuals can be said to have learned equal amounts. He also suggested that research should be completed using different retention intervals to determine if longer intervals cause greater differences between mentally retarded and non-mentally retarded subjects.

Chasey (1971) studied the effect of motor skill overlearning on retention by institutionalized mentally retarded subjects. Ninety-eight subjects who resided at the Austin State School in Houston, Texas were tested on a modification of the Johnson Mat Test. Two levels of motor learning were selected and the subjects were randomly assigned to Group I (learning) and Group II (overlearning). Learning occurred when the subjects completed Levels I and II one time without error. Overlearning occurred when the subjects completed Levels I and II three consecutive times without error. Subjects were tested for retention four weeks after the initial learning session. The number of trials required to complete Levels I and II were recorded and analyzed using the pretest/posttest design. Analysis of the data indicated that the mentally retarded subjects who overlearned the motor task maintained significant retention of the task after four weeks of no reinforcement, compared to those subjects who learned, but did not overlearn the task.

In a follow-up study, Chasey and Knowles (1973) investigated motor skill overlearning effects on retention and relearning by mentally retarded boys. The stabilometer was used to study the effects of 50, 100, and 150% overlearning on retention and relearning by 100 mentally retarded boys after 8 weeks of no practice. All subjects practiced to a learning criterion at which point the instruction stopped. The overlearning groups continued practicing until they attained their designated overlearning levels. The findings of the study supported the contention that overlearning is important in retention and relearning by mentally retarded boys. The results also indicated that boys who are mentally retarded are capable of learning a gross motor task involving rapid adjustive cues to vestibular and kinesthetic sensations.

Audie (1981) examined the effect of overlearning on the acquisition and retention of a continuous motor skill by moderately mentally retarded individuals. Thirty moderately mentally retarded subjects, ages 7.4 to 14.7, from Bryant School in Spokane, Washington, were randomly divided into three experimental conditions: (1) learning, (2) 50% overlearning, and (3) 100% overlearning. Each subject was given a maximum of 20 trials on the dynabalometer. Each trial was 30 seconds long, with 30 seconds rest between trials. Subjects practiced until they reached their respective criterion. Following 28 days without practice, all subjects were tested for retention. Retention was measured by time-in-balance, trials-to-criterion, and performance scores. Savings scores were also computed, plotted, and analyzed. Audie found that overlearning did not significantly affect the amount of retention of a balancing task by mentally retarded subjects.

Trials-to-Criterion

Several investigators have indicated that an important factor in retention is the level of proficiency attained during initial learning or original learning (Ammons, 1958; Baer, 1940; Purdy & Lockhardt, 1962; Schmidt, 1982; Shifflett, 1985). There is little agreement on the desired number of TTC and the relationship to retention. The original learning criterion has been set at one correct throw (Chasey, 1971), two consecutive correct throws (Audie, 1981), three consecutive correct throws (Chasey, 1971), four consecutive correct throws (Delmore, 1975), and five consecutive correct throws (Sorenson, Hooper, & Spray, 1982). Shifflett (1985) in her review of TTC found that the performance of one correct time was the most consistent criterion used with paired associates or paired word lists. The motor learning literature is inconsistent on the recommended number of TTC.

It is apparent that there is a dearth of research supporting the appropriate number of TTC on original learning and its relationship to retention. Little if any current research exists using mentally retarded youth in studies involving TTC.

Summary

Based on the review of related research, the following observations were made:

- 1) Overlearning is recognized as important in the retention of gross and fine motor skills (Burwitz, 1973; Chasey, 1971; Chasey, 1977; Chasey & Knowles, 1973, Delmore, 1975; Lance, 1965;

Llewelyn, 1974; Marquardt, 1977; Melnick, 1971; Rarick et al., 1976; Singer, 1975; Vergason, 1964). The application of overlearning has been accepted as a means to enhance the retention of motor skills for mentally retarded individuals.

- 2) There are contradictions in the literature regarding the effect of various degrees of overlearning on the retention of motor skills, (Audie, 1981; Chasey, 1971, 1977; Chasey & Knowles, 1973; Delmore, 1975).
- 3) Subjects have been exposed to 0, 50, 100, 150, and 200% overlearning. Melnick (1971) found that it was unreasonable to use overlearning greater than 150% when one considers the unwarranted amount of time it takes to attain 200% overlearning.
- 4) Original learning criterion or TTC have been arbitrarily set by various investigators. There is little agreement regarding the level of original learning desired prior to the application of overlearning.
- 5) The retention interval of 28 days was chosen since changes in retention, if they were to occur, would take place within the 28-day period of time (Audie, 1981; Chasey, 1971; Delmore, 1975; Ellis et al., 1960; Melnick, 1971; Scott, 1971).
- 6) Mentally retarded individuals do not spontaneously attend to cues while learning motor tasks. This behavior causes the information in STM to be stored in an unorganized manner. Mentally handicapped individuals lose much of the stored information in STM.

- 7) Teaching mentally retarded individuals to rehearse may increase their ability to recall motor skills and nonmotor tasks, such as moving through an obstacle course or learning word lists.
- 8) Controlling attending behaviors of mentally retarded subjects may increase their ability to rehearse motor tasks.
- 9) Long term memory may be improved by using meaningfully sequenced motor tasks.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study was to determine the effect of the number of trials-to-criterion on the retention of a discrete motor skill (overhand beanbag throw) by moderately mentally retarded and severely mentally retarded individuals. Information in Chapter III is organized into the following sections: selection of subjects, selection of task, design of the study, collection of data, and statistical treatment of data.

Selection of Subjects

Of the 90 subjects used for this study, 60 were mentally retarded subjects selected from Fairview Training Center in Salem, Oregon, and 30 were nonhandicapped students, selected at random from the Corvallis, Oregon public schools, used as the control group. Only subjects who met the following criteria were accepted for inclusion in this study: (1) severely mentally retarded subjects with visual acuity correctable to 20/200, an IQ of 21 to 35, a mental age of 2.1 years to 7 years, the ability to grasp a beanbag, a chronological age of 9 to 20 years, a hearing deficit no greater than 60db, and the absence of neuromuscular abnormalities such as cerebral palsy and orthopedic impairments which might influence throwing capabilities; (2) moderately mentally retarded subjects with visual acuity correctable to 20/200, an IQ of 36 to 51, a mental age of 2.9 to 10.2 years, the ability to

grasp a beanbag, a chronological age of 9 to 20 years, a hearing deficit no greater than 60db, and the absence of neuromuscular abnormalities such as cerebral palsy and orthopedic impairments which might influence throwing capabilities; and (3) nonretarded subjects in age range from 11 to 18 years with visual acuity correctable to 20/200, an IQ ranging from 90 to 115, a hearing deficit no greater than 60db, and the absence of neuromuscular abnormalities such as cerebral palsy and orthopedic impairments which might influence the ability to grasp and throw a beanbag.

Mental retardation was determined by standardized tests given by the Fairview staff. Participation in this research was voluntary and required permission from the subjects' parent(s), legal guardian, or surrogate parents. Testing sites were determined by the administrations of the Fairview Training Center and Corvallis, Oregon public schools.

Selection of Task

Preference for a particular throwing action was not evident from the review of the literature. Several different throwing patterns have been used in similar studies, including the underhand throw (Chasey & Knowles, 1973) and the bounce pass (Delmore, 1975). The overhand throw was selected as the discrete motor task for this study because: (1) The basic skill pattern, once learned, can be used in a variety of activities; (2) the activity can be conducted almost anywhere; (3) the skill provides an opportunity for social interaction once it is learned, e.g., using the skill in a game of catch; and (4) the task analysis is easy for the teacher to follow (Appendix A). A 2-inch square beanbag was used as the object to be thrown because it is easier to grasp than other items which are commonly used. The beanbag was

thrown overhand from a standing position at a target at a distance of 10 feet. Hitting the inner circle of the target was the desired motor response (Appendix B).

In previous studies of TTC, overlearning, and retention, there was no apparent difference in the results of the studies when throwing distances of 8, 10, and 16 feet were used. Chasey (1971) used 8 and 16 feet, while Delmore (1975) used 10 feet, which she regarded as a challenging throwing distance. Vodola (1980) developed a nationally validated motor ability and physical fitness test battery for mentally retarded, non-mentally retarded, learning disabled and emotionally disturbed individuals. Several overhand throwing tasks were incorporated into the test, and a distance of 10 feet was used.

Various circular target designs have been used to measure throwing skills of individuals who are mentally retarded (Chasey & Knowles, 1973; Delmore, 1975; Rarick & McQuillan, 1977; Sorenson, Hooper, & Spray, 1982). Delmore found that using a circular target with an enlarged green frog was helpful in maintaining a greater degree of attention to task. For this study, target preference was determined during the pilot study. Subjects preferred a circular target design with an enlarged drawing of a cat at its center which, when contacted, emitted a sound and a light flash. A memorandum was sent to teachers of the classrooms from which the subjects were drawn requesting that they eliminate overhand throwing activities through the duration of the study. Practice of the specific skill outside the experimental treatment was unlikely due to the unique design of the target and the use of beanbags.

Design of the Study

The literature in the motor learning area is inconsistent with respect to the recommended number of TTC used with mentally retarded subjects. This study was designed to determine which level of TTC may result in the best retention of a discrete motor task. Within each group (i.e., nonhandicapped, moderately mentally retarded, and severely mentally retarded), subjects were randomly assigned to one of three conditions: 2, 3, or 4 TTC (Table 1). Each subject practiced the skill until the respective criterion level was reached. Studies with hearing impaired students in physical education (Hassan, 1983), speech and hearing (Harris, 1981), counseling (Bernal, Klinnert, & Schultz, 1980), physical education (Paciorek, 1981), and special physical education (Maguire, 1985) utilized an eight-week treatment interval. Due to the success of these previous studies, an eight-week instructional period was chosen for the current study.

Table 1. Experimental Design: 3×3 (levels of retardation \times TTC)
Generalized, Randomized Block ANCOVA.

Blocked Factor (degree of retardation)		Covariate (pretest)	TTC	Treatment Factor	Depen. Var. (posttest)
Nonhandi- capped	n=10	No. of attempts	2	4 weeks reten- tion interval	No. of attempts
	n=10	"	3	"	"
	n=10	"	4	"	"
Moderately Retarded	n=10	"	2	"	"
	n=10	"	3	"	"
	n=10	"	4	"	"
Severely Retarded	n=10	"	2	"	"
	n=10	"	3	"	"
	n=10	"	4	"	"

The investigator worked with each subject for approximately 15 minutes per day, using the OSU/TR Data Based Instructional Model (Appendix C). Subjects performed the skill until the learning criterion was met, meeting with the investigator for 3 instructional sessions per week for a maximum number of 24 sessions through an 8-week maximum time duration. The sessions were equally spaced, with a time interval for both experimental and control groups of no more than two days between sessions. If the subjects failed to meet the criterion in 8 weeks, their participation in the study was discontinued. A 4-week no-practice interval (28 days) was initiated as soon as the criterion level was met. Four week was selected as the retention interval because previous studies have demonstrated that this interval of time is effective for retention studies. Mean differences in retention scores for longer periods of time have been found to be non-significant (Audie, 1981; Chasey, 1971; Delmore, 1975; Ellis et al., 1960; Melnick, 1971; Scott, 1971).

After the four-week no-practice interval, the subjects were given a posttest in which two consecutive correct attempts were used as criterion for retention to determine if the skill had been retained. If the two consecutive attempts were not successful, the student was provided instruction until the criterion of two consecutive correct attempts was reached. The total number of attempts it took each subject to reach criterion after the no-practice interval was utilized to analyze the effect of the number of TTC on retention of the skill. Tabulating the attempts to reach the learning criterion is considered to be the most sensitive measure of retention (Kerr, 1982; Oxendine, 1968).

Instructional Method

The learning theory used in this study was based upon the work of Skinner (1965). This approach, known as operant conditioning, stresses the sequential development of behaviors to increase the probability that a skill will be learned. The stimulus-response-reinforcement pattern continues until the material is learned. The learner is not allowed to move on until the prerequisite skills are achieved. The research literature supports that the best results with mentally retarded individuals are achieved with the use of behavior modification techniques (Fredericks, Baldwin, Moore, Templeman, Grove, Moore, Gable, Blair, Alrick, Wadlow, Fruin, Bunse, Makohon, Samples, Moses, Rogers, & Toews, 1977). Gardner (1971) strongly supports the use of behavior management techniques:

Results of the application of behavior management techniques provide illustration of behavior change of a range, degree, and rate that most psychiatric, psychological, rehabilitation, and educational personnel had not thought possible due to the limitations assumed to be inherent in mental retardation. (p. 22)

Instructional methodology (Appendix C), using a behavior management approach, is presently incorporated in classrooms and physical education programs for severely and profoundly handicapped students (Fredericks, et al., 1977; Dunn et al., 1986). This methodology has been nationally validated as a process which assists mentally retarded children to acquire information. The methodology is based upon three components: the cue, behavior, and consequence. The cue is the sign, signal, command, or stimulus that calls for the occurrence of a behavior. For example, the cue, "Jim, throw the

beanbag," is task specific and sensitive to the receptive language level of each subject. Consistent cues greatly reduce the absolute amount of information to be encoded by mentally retarded individuals (Spitz, 1979).

The second major component of the model is the motor behavior, or task analysis, which consists of a series of subtasks or phases. When learned in the proper sequence, these phases constitute a completed motor skill. The throwing task utilized in this study has been broken down into sequential developmental parts and is referred to as the task analysis.

The third major element of concern is the consequence. After the student performs the motor behavior, the subject is provided feedback concerning the performance of the skill. Following a correct motor response, reinforcers are given immediately to strengthen the probability that the motor response will occur again.

The instructional process utilized in this study began with the delivery of a verbal cue. When the cue was given and the task was performed correctly, the student was immediately reinforced. If the subject's performance did not meet criterion, a consequence was delivered immediately, e.g., "No, Jim." At this point the skill was modeled and the subject was recued, e.g., "Jim, throw the beanbag." If the performance was correct, the subject was mildly reinforced; if the skill performance did not meet criterion, the subject was informed again that something was wrong, e.g., "No, Jim." Jim was recued and physically assisted through the skill, mild reinforcement was given, and the data were recorded. This process was repeated for the next trial. The instructional process was consistent across the treatment and control groups (see Appendix C for a diagram of the instructional process).

Collection of Data

Collection of the data was on a trial-by-trial basis. If a performance on a trial was correct, an "X" was recorded on the data sheet (Appendix D). If the student's performance did not meet criterion on a trial but was performed correctly after the model, an "M" was recorded on the data sheet (operationally defined as equaling two attempts). If the subject failed as well to meet criterion on the verbal cue following the model, physical assistance was provided and a "P" recorded on the data sheet (operationally defined as equaling three attempts). Hence, the total number of attempts recorded, for any one trial ranged from one to three. Scores for each subject were updated daily. The data for the handicapped subjects were collected in a multi-purpose room at Fairview. The subjects were brought to the lab and returned to their classrooms by the Fairview staff. Aides were present to assist with any behavior problems. The Corvallis Public Schools provided the use of a gymnasium to conduct the research with the nonhandicapped subjects.

Statistical Treatment

The experimental design utilized for this study was the 3×3 (Level of Retardation \times TTC) generalized randomized block analysis of covariance design, with level of retardation as a fixed blocking factor, TTC method as the treatment factor, and the pretest as the covariate (Table 2). The dependent variable was a posttest, consisting of the number of attempts to reach two consecutive successful trials. This design is one of the recom-

mended approaches in the methodological research literature (Kirk, 1985). Courtney (1983) has described the analysis of covariance (ANCOVA) as a statistical technique which combines the concepts of analysis of variance and regression in situations where the researcher cannot completely control all of the variables. This procedure tests for differences among means of the dependent variable, while accounting for differences among the groups with respect to the covariate. The ANCOVA adjusts the mean of the dependent variable for its relationship with the covariate using regression analysis procedures. By making this adjustment, experimental errors are reduced and the experiment becomes more powerful for studying treatment effects. In addition, sampling errors are reduced and the precision of decisions increased.

Table 2. General Randomized Block ANCOVA.

Source of Variation	df	SS	MS	F-calc
Covariate	1	SSC	MSC	MSC/MSE
Treatment	2	SST	MST	MST/MSE
Block E	2	SSB	MSB	MSTB/MS
Interaction E	4	SSTB	MSTB	MSTB/MS
Error	80	SSE	MSE	
Total	89			

The ANCOVA was utilized to determine if significant differences existed among treatment and control groups with the posttest scores adjusted for the initial difference in pretest scores. The number of attempts

required to reach the specified TTC for the pretest served as the covariate and was used to adjust the dependent variable, the posttest. When significant differences were found among the treatment and the control group, the Newman-Keuls procedure (1952) was used to determine the source of the differences.

The sample size for each cell was calculated by using the data generated from the pilot study, as well as the formula listed in Kirk (1985). The n was calculated at 8.65 and was set at 10 to give some margin of error in the event students changed residential settings or failed to meet criterion. To maintain an 80% probability that a false null hypothesis would be rejected, a power of .80 was chosen. The power was calculated again after the collection of the data to insure that the power projected from the pilot study was representative of the subjects used in the study. The .05 alpha level was selected because of its common acceptance (Courtney, 1982) and to ensure that the probability of making a type I error was 5 percent or less.

The mathematical model which follows represents the statistical treatments used in this study:

$$Y_{ijk} = \mu \dots + \beta_i + \tau_j + (\beta\tau)_{ij} \\ + \delta(X_{ijk} - \bar{x} \dots) + \epsilon_{ijk}$$

where μ = the overall mean of the dependent variable,

β_i = constants for the block effects, subject to the restriction
 $\sum \beta_i = 0,$

τ_j = constants for the treatment effects, subject to the restriction
 $\sum \tau_j = 0,$

$(\beta\tau)_{ij}$ = constants for the interaction of block and treatment, subject to the restriction

$$\sum_i (\beta\tau)_{ij} = \sum_j (\beta\tau)_{ij} = 0,$$

- δ = a regression coefficient for the relation between x and y ,
 X_{ijk} = known constants, namely the value of the covariate for the
 i^{th} block, j^{th} treatment, k^{th} individual,
 $\bar{x} \dots$ = the overall mean of the covariate, and
 ϵ_{ijk} = the independent $N(0, \sigma^2)$ variable terms.

The following hypotheses were tested:

- 1) $H_0^1: \delta = 0$ (no relationship between covariate and the dependent variable),
 $H_a: \delta \neq 0$.
- 2) $H_0^2: \tau_1 = \tau_2 = \tau_3 = 0$ (no treatment effects),
 $H_a: \text{not all } \tau_j \text{ are zero;}$
- 3) $H_0^3: \beta_1 = \beta_2 = \beta_3 = 0$ (no block effects; groups are the same),
 $H_a: \text{not all } \beta_i \text{ are zero;}$
- 4) $H_0^4: (\beta\tau)_{ij} = 0$ for all $i, j = 1, 2, 3$ (no interaction between blocks and treatment),
 $H_a: \text{not all } (\beta\tau)_{ij} \text{ are zero; and}$

CHAPTER IV

PRESENTATION AND DISCUSSION OF FINDINGS

The purpose of this study was to analyze the effect of the number of trials-to-criterion (TTC) on the retention of a discrete motor skill (overhand beanbag throw) by moderately and severely mentally retarded individuals. Retention was measured for 30 non-mentally retarded subjects, 30 moderately mentally retarded subjects, and 30 severely mentally retarded subjects. Subjects were randomly assigned by level of retardation to one of three TTC treatment groups: two consecutive correct trials; three consecutive correct trials; and four consecutive correct trials. The discussion and summary of the findings are presented in this chapter.

A generalized, randomized block ANCOVA was used to test the null hypotheses. The treatment factor was TTC and level of retardation was considered as a fixed blocking factor. The dependent variable was the posttest score and the pretest score served as the covariate. The posttest mean data were collected for each subject and standard deviations and mean posttest scores for the three levels of TTC and mental retardation are presented in Table 3.

Table 3. Adjusted Means and Standard Deviations for the Posttest Scores by Group and Trials-to-Criterion (TTC).

GROUP		2TTC Post	3TTC Post	4TTC Post	Mean Scores MR ¹
NMR	\bar{X}	8.77	9.28	8.26	8.77
	SD	(1.84)	(2.26)	(1.70)	
MMR	\bar{X}	20.28	5.57	5.53	10.46
	SD	(19.90)	(7.17)	(8.33)	
SMR	\bar{X}	36.14	8.08	8.38	17.53
	SD	(30.94)	(6.93)	(13.53)	
Mean Scores TTC ²		21.73	7.64	7.39	

Notes:
¹ Mean of adjusted posttest means scores for MR.
² Means of adjusted posttest mean scores for TTC.

Findings

Hypothesis One (Ho¹): There is no relationship between the pretest and posttest mean scores

The calculated F-ratio for this hypothesis was 8.21, with a corresponding p-value of .0053. Since $p = .0053$ and is less than .05, the hypothesis was rejected. It was concluded that there is a relationship between pre and posttest scores and that, as a result of the treatment effect, the subjects' scores improved. The decrease from pretest to posttest scores is very apparent as indicated in Figure 1. The decrease in mean scores for all treatment groups was statistically significant. The control group (non-mentally retarded) did show an increase in attempts from the pretest to the posttest. This was due to the adjustment made on the mean scores when

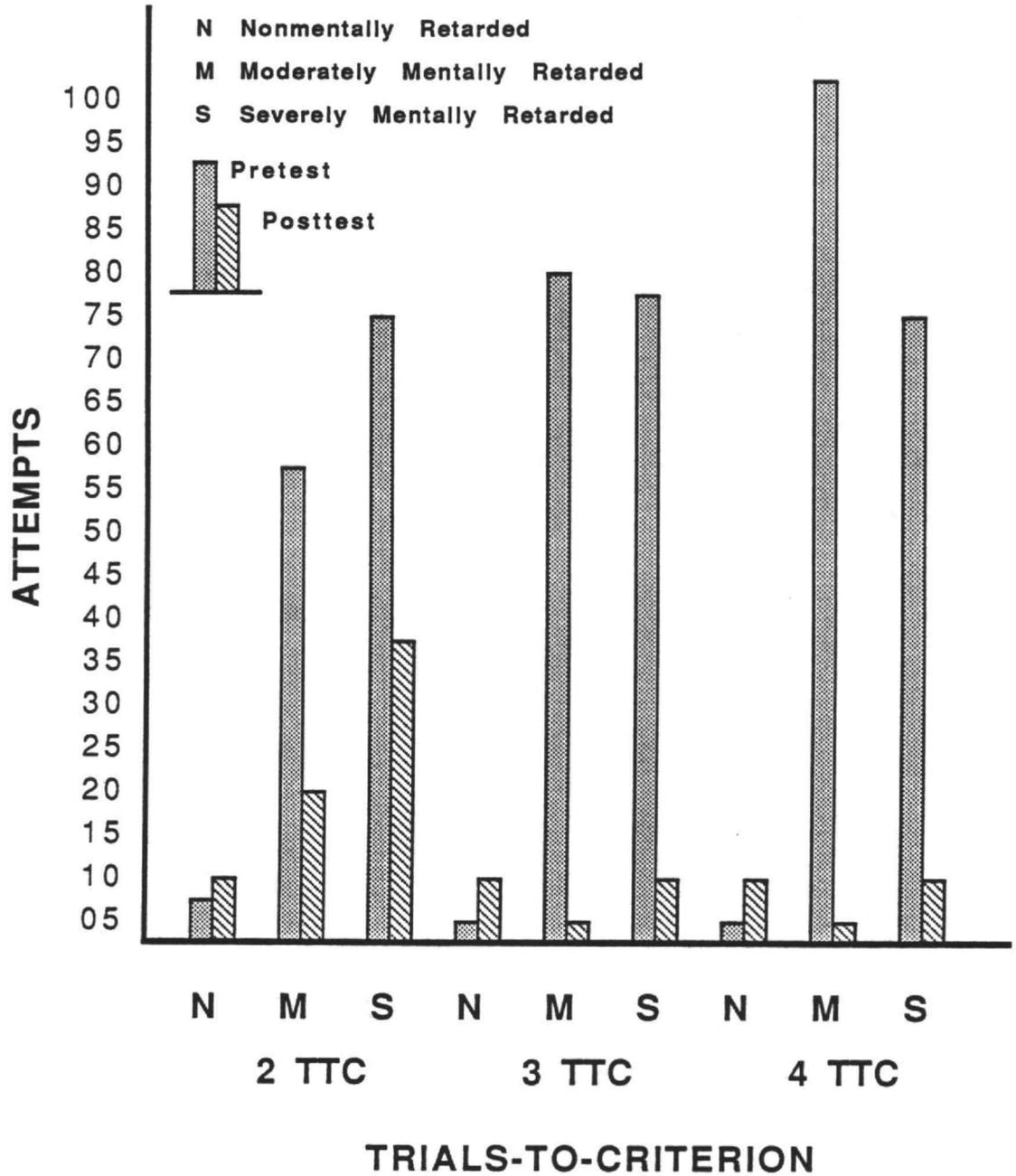


Figure 1. Pretest/Adjusted Posttest Cells Means.

the ANCOVA was used. A discussion of the nature of the relationship between pretest and posttest scores will be reviewed under Hypothesis Four.

The treatment groups experienced a decrease in scores from the pretest to the posttest. This difference may have been related to the number of TTC or the level of retardation. Hypotheses Two and Three were included to analyze these factors.

Two subjects were removed from the study upon their placement in foster homes. Kirk (1985) suggests that the adjusted posttest mean scores be used in the place of the missing posttest scores as long as the number of subjects in each cell do not fall below the calculated number needed to maintain a power of .80. The ratio between males and females in the study was similar to the ratio found in the special population at Fairview. There were no significant differences between pretest and adjusted posttest means when compared for gender differences. The increase in posttest scores over pretest scores is due to the adjusted posttest means and the ceiling effect.

In summary, there was a relationship between the covariate (pretest score) and the dependent variable (posttest score), which is statistically significant ($p = .0053$). Therefore, the first hypothesis, that there is no relationship between the pretest means and the adjusted posttest means, was rejected.

Hypothesis Two (H_0^2): There is no treatment effect for trials-to-criterion.

Within each group (nonhandicapped, moderately mentally retarded, and severely mentally retarded), subjects were randomly assigned to one of three conditions: 2, 3, or 4 TTC. The intent of this phase of the study was to

determine which criterion level had the greatest effect on retention of a discrete gross motor skill. A 3×3 generalized, randomized block ANCOVA was conducted with level of retardation as a fixed blocking factor and the pretest score as the covariate.

The calculated F-ratio for this hypothesis was 11.31, with the corresponding p value less than .0001 (Table 4). Since the p-value was less than .05, this hypothesis was rejected and it was concluded that there is a treatment effect for the level of TTC. The means of the adjusted posttest means for the three levels of TTC, 2, 3, and 4 were, respectively, 21.73, 7.64, and 7.39 (Figure 2). While these data suggest that there are differences among the three levels of TTC, the presence of an interaction effect precludes the drawing of comparisons among the TTC means. The interaction effect will be discussed under Hypothesis Four.

Table 4. ANCOVA of the Difference Between Pre/Posttest Scores for TTC.

	Df	SUM OF SQUARES	MEAN SQUARE	F	p-VALUE
PRETEST (COVARIATE)	1	437.99380	437.99300	8.21	.0053
GROUP	2	1002.92957	501.46479	2.86	.0630
CRITERIA	2	3960.83480	1980.41740	11.31	.0000
GROUPS X CRITERION	4	2601.23652	650.30913	3.71	.0080
ERROR	80	14013.30620	175.16633		

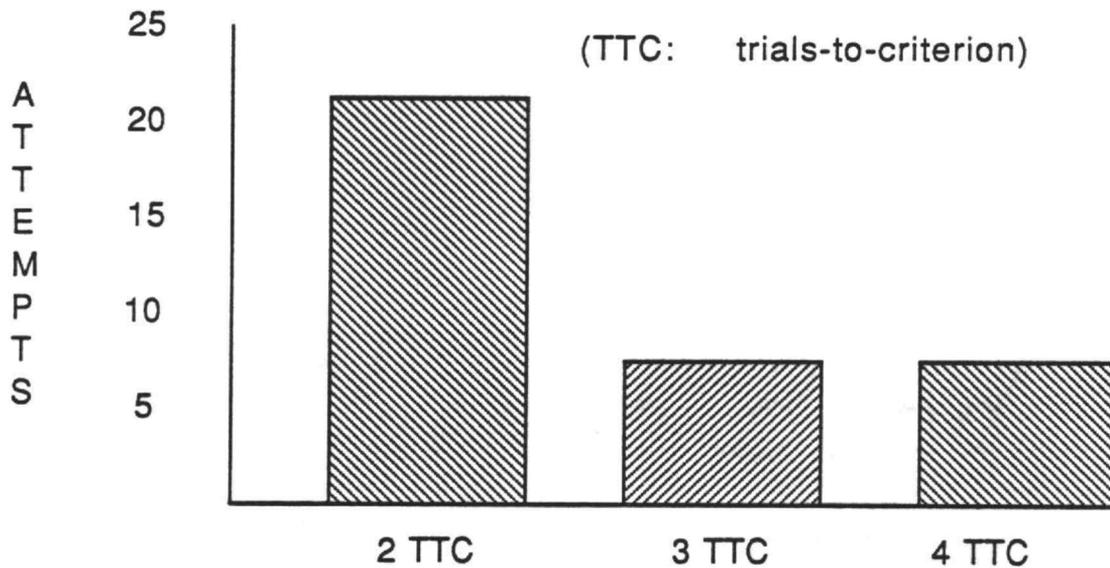


Figure 2. Adjusted Posttest Mean Scores By TTC.

Mentally retarded subjects who completed three or four TTC in initial learning appear to have retained the throwing skill better than those who completed two TTC. These results were consistent with several other studies (Ammons, 1958; Chasey, 1971; Chasey, 1977; Chasey & Knowles, 1973; Heber, Prehm, Nardi, & Simpson, 1962; Lance, 1965) which reported significant differences in retention by mentally retarded subjects who had experienced a greater number of initial trials.

Chasey and Knowles (1973) examined the effect that additional trials of a gross motor skill had upon the retention and relearning of a throwing skill among institutionalized retarded males. They concluded that overlearning had an influence upon the improved performance of the task and that overlearning was an important variable in the retention of a gross motor task.

Chasey (1971) found that subjects who overlearned a skill scored above the median on performance and that there was no significant deficit in long-term retention by those subjects. Requiring more trials of a mentally retarded subject may influence the ability to retain a discrete motor skill. Subjects who require additional trials to learn a skill receive more exposure to the skill, as well as more chances for knowledge of results and positive feedback. It was anticipated that if moderately and severely mentally retarded subjects were exposed to a greater number of trials, retention of a motor skill would be facilitated. This anticipation was, in fact, supported in this study.

The results of this study did not support several earlier studies (Audie, 1981; Cantor & Ryan, 1962; Lott, 1958; O'Conner & Hermelin, 1963), which found no significant differences when comparing the effects of additional trials on retention by mentally retarded and non-mentally retarded subjects. Several conditions could have contributed to the apparent contradictions in these studies. Audie (1981) used a balancing activity which incorporated control in five directions: left, right, forward, backward, and rotational (the combination of the first four listed). This is a complex activity, and it is possible that the skill Audie used was too difficult for the mentally retarded subjects.

Lott (1958) used a paired-associates learning task (pictures of common objects). Subjects were brought to the original learning criterion of four consecutive correct trials. One week and one month later the subjects were given the retention test of one perfect trial. Lott found no significant difference among the groups on original learning or their ability to generalize over a one- or four-week relearning interval. Several problems were apparent in the methodology used by Lott. It appears that the skill was too

easy, since the mean scores between the non-mentally retarded and the mentally retarded subjects were very similar. The subjects who easily re-learned the skill would experience a floor effect, and differences in the scores would be difficult to detect.

Cantor and Ryan (1962) used similar methodology to that of Lott (1958), but increased the number of paired-associates to 12 and required subjects to complete the task two consecutive times. The retention intervals were the same and the results were similar to those of the Lott study, and no significant original learning differences were observed. A floor effect was apparent with the non-mentally retarded subjects which, in turn, may have obscured the results when scores were compared.

In summary, the main effect of TTC on retention was statistically significant ($p \geq .05$). Therefore, the second hypothesis, that there is no treatment effect for TTC, was rejected.

Hypothesis Three (H_0^3): There is no effect for retardation.

The subjects were non-mentally retarded public school students, and moderately mentally retarded and severely mentally handicapped institutionalized individuals. The subjects ranged in age from 9 to 20 years. The F-test was used at the .05 level of significance to determine whether differences in performance existed among the three populations. The calculated F-ratio for this hypothesis was 2.85 with a corresponding p-value of .0630. Since the p-value was greater than .05 and only approached significance (Table 4), Hypothesis Three was retained. This suggests there were no differences among the three groups. Although this finding was unexpected, a significant interaction was found in the testing of Hypothesis Four, suggesting that there

may be differences among the groups which are concealed because of the block by treatment interaction.

Non-Mentally Retarded Group

The NMR group achieved the criteria more quickly than either the MMR group or the SMR group. The total number of attempts by the NMR group was also considerably fewer. The non-mentally retarded group had a notably higher level of performance, i.e., a posttest mean score of 8.77 (Figure 3), with all subjects meeting the original learning criterion by the second day of the study. The adjusted posttest mean and standard deviation scores for the NMR subjects did not improve across the three levels of TTC, which may be attributed to a ceiling effect often experienced when subjects are highly skilled and the required task is easily achieved.

Moderately Mentally Retarded Group

The adjusted posttest mean score of the MMR subjects' was 10.86, higher than the NMR subjects' score (8.77) and less than the SMR subjects' score (17.53). As the level of retardation increased, so did the number of attempts needed to meet criterion. The MMR are generally believed to be two to four years behind their NMR peers in measures of motor proficiency (Francis & Rarick, 1959), while the MMR perform motor skills better than their SMR peers.

Generally, with the mentally retarded, as the level of intelligence decreases, a corresponding decrease is found in motor performance. Cratty (1974) measured levels of specific motor skills between mildly and moderately mentally retarded and found that performance levels deteriorated as the level of retardation increased and that the mildly retarded performed better than the moderately retarded, but not as well as the nonretarded. Geddes

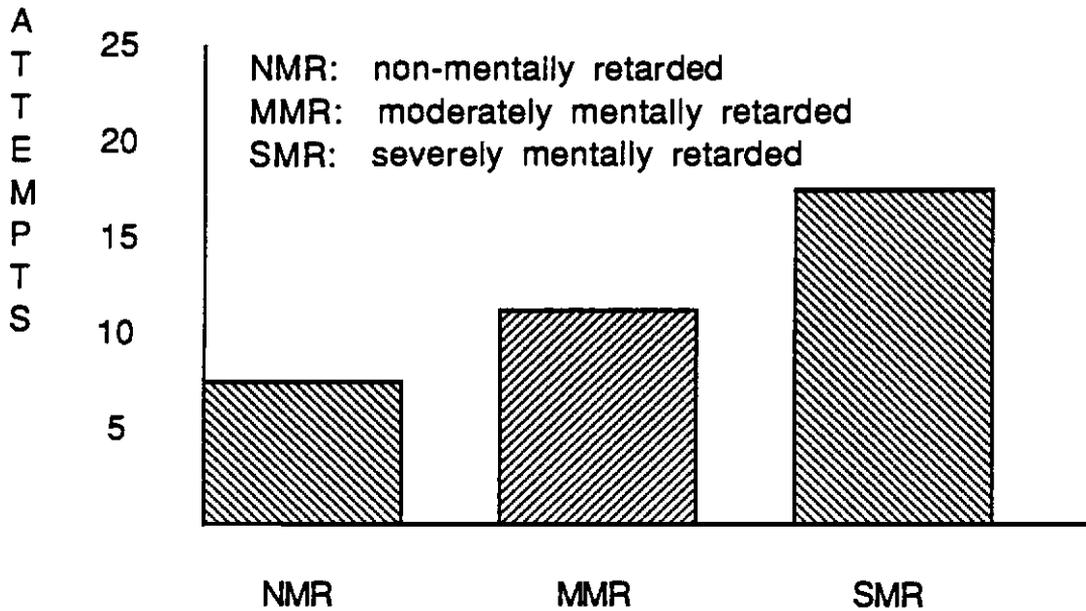


Figure 3. Adjusted Posttest Mean Scores By Level of Mental Retardation.

(1981) summed up the findings by stating that mentally retarded children are inferior in motor performance when compared with nonmentally retarded peers. This study appears to support the contention of Geddes.

Severely Mentally Retarded Group

The adjusted posttest mean score (17.53) for the SMR was notably greater than the other two groups. Studies of the motor characteristics of severely retarded individuals reveal wider margins of motor skill deficits than among moderately retarded subjects (Cratty, 1974; Francis & Rarick, 1959; Geddes, 1981; Rarick & McQuillan, 1977; Rarick, Widdop, & Broadhead, 1970).

Discussion of Hypothesis Three

The third hypothesis was designed to determine the effect of two levels of mental retardation on the retention scores of a gross motor skill. The calculated F-ratio for Hypothesis Three was 2.86 with a corresponding p-value of .0630. Since the p-value is greater than .05, the third hypothesis, that there is no effect for retardation, was not rejected (Table 4). However, the direction of the findings and the influence of various levels of retardation should not be disregarded by educators when selecting criterion levels for learning. This variable is worthy of additional study.

The non-mentally retarded subjects appeared to perform more successfully than the moderately mentally retarded subjects and the moderately mentally retarded subjects seemed to perform better than the severely mentally retarded subjects. However, the statistical analysis indicated no significant differences among these three groups. The lack of significant difference among the levels of retardation may partially be attributed to a high degree of variability with regard to gross motor skills among mentally retarded children.

Hypothesis Four (Ho⁴): There is no interaction effect between the levels of retardation and TTC.

As reported in Table 3, the calculated F-ratio for Hypothesis Four was 3.71 with a corresponding p-value of .0080. Since $p = .0080$ is less than .05 this hypothesis was rejected and it was concluded that there is a relationship between level of retardation and the number of TTC. Further analyses of the adjusted posttest means were conducted for pairwise

comparisons of the adjusted means for 2, 3, and 4 TTC groups and levels of retardation. The Neuman-Keuls (1952) procedure, which uses a sequential approach to significance testing, was employed. The adjusted posttest means for TTC scores ordered from small to large are included in Appendix E. This table also includes the critical values for a .05 level test arranged in order of magnitude. The difference between the two means being compared must be greater than the critical value to represent a significant difference.

The multiple comparisons indicated that the adjusted posttest means of the SMR at two TTC were significantly higher than all other comparisons, with the exception of 2 TTC MMR adjusted posttest mean scores, which were similar to those for the SMR. These analyses indicate that there were significant differences between the two TTC SMR group and the three and four TTC SMR MMR and NMR groups. The difference between the two TTC SMR group and the two TTC MMR group approached significance. However, no significant differences in retention scores were found between the two TTC, three TTC, and four TTC for the nonmentally retarded or moderately mentally retarded groups. The two TTC SMR group was significantly different in retention than the three TTC or four TTC groups, but no significant differences were observed between the three TTC SMR and four TTC SMR groups.

The moderately and severely mentally retarded subjects required additional posttest trials to master the skill as the criterion level decreased. Winters & Gerjuoy (1969) suggest that the moderately and severely mentally retarded do not process information as well as non-mentally retarded subjects. Their ability to attend to the task at hand and process the motor patterns is less methodical and patterned. The MMR and SMR subjects have

a tendency to persevere on a particular stimulus and miss additional information, which may interfere with learning. Spitz (1971) suggests that the performance at a lower level may be due to the inability of mentally retarded individuals to attend to a specific skill when they are bombarded with many stimuli. As the inability to attend increases, the ability to process and store the motor task in a meaningful manner diminishes (Porretta, 1982; Spitz, 1973). This leads to faulty retrieval of the information needed to perform a task. However, MMR and SMR individuals can be trained to rehearse (Robinson, 1976), suggesting that information can be retained if a systemized process is used to assist in coding the information. Mentally retarded subjects have increased their ability to recall information by 30% when a skill was actively rehearsed in a controlled setting (Cuvo, 1983; Ellis, 1970).

Using a didactic form of instruction, the Data Based Gymnasium model may have provided the MMR and SMR subjects an opportunity to organize information more accurately, which may explain the improved scores on the posttest. The increased transfer of information from short term memory to long term memory may also be facilitated by requiring additional trials before a task is considered learned. Skills learned under a condition of increased TTC may deter the loss of the skill over time (Brown et al., 1971).

A plot of the adjusted posttest means (Figure 4) illustrates that for SMR and MMR groups fewer attempts were required to reach criterion at three TTC and four TTC compared to two TTC. The trend was similar for both the severely and moderately mentally retarded subjects and similar results were found across all three NMR groups regardless of the TTC treatment.

S = severely mentally retarded
M = moderately mentally retarded
N = nonmentally retarded

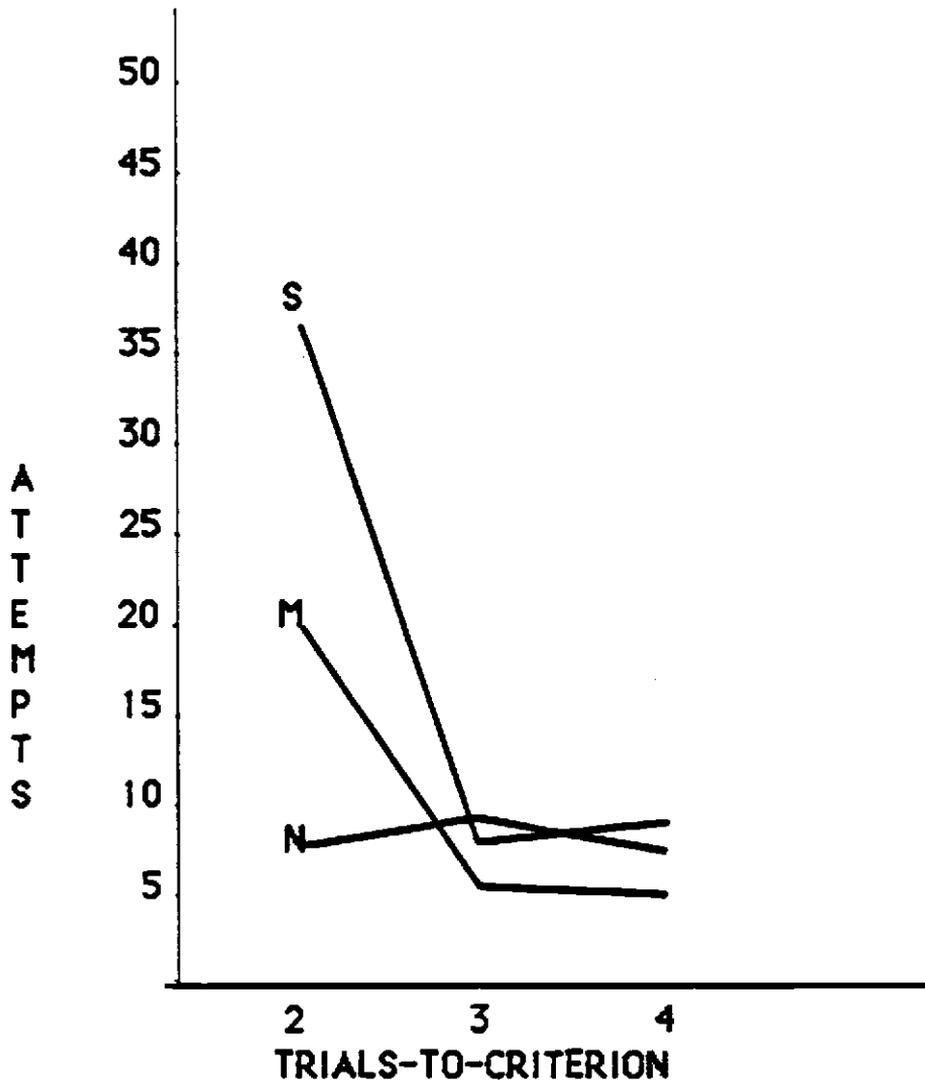


Figure 4. Adjusted Cell Means for Posttest Scores.

Summary

The results of the present investigation suggest, following the treatment effect of TTC, that there is a significant change in performance from pretest to posttest scores on a discrete overhand throwing skill by moderately and severely handicapped subjects. The adjusted posttest mean scores for attempts needed to reach TTC decreased as the criterion levels 2, 3, and 4 increased. The level of TTC had a positive effect on the performance of a discrete gross motor skill after a 28 day retention interval. In this study, fewer trials were needed to reach posttest criterion for both three and four TTC. Lower TTC levels may negatively influence the mentally retarded subjects' ability to perform a throwing task after a 28-day retention interval. The practice of increasing TTC should be incorporated into instructional physical education programs for institutionalized retarded individuals.

This finding is important for teachers who must determine which criterion will give the mentally retarded student the greatest chance for success. The difference between two TTC and three and four TTC for the mentally retarded was evident in this study, with significance obtained for the SMR group.

As the level of retardation increased, so did the adjusted posttest mean score of the attempts needed to reach criterion. The moderately mentally retarded subjects had a lower adjusted posttest mean score (10.46) than did the severely mentally retarded subjects (17.53). The difference between the MMR and the SMR at the two TTC level was not significant. The subject variability within groups was very high and this may have contributed to

the absence of differences among the two groups. This reinforces the belief that SMR subjects need more time to reach a higher criterion but that once they learn a skill they can relearn it in a shorter period of time.

It is apparent that both moderately and severely mentally retarded individuals benefit from increasing the criterion level for acquiring gross motor skills. The important issue is that three and four TTC appear to enhance the ability of both the moderately and severely mentally retarded individuals to maintain a higher level of retention of a gross motor task.

CHAPTER V

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the effect of three levels of trials-to-criterion (2, 3, and 4 consecutive correct trials) on the retention of a discrete motor skill (overhand bean bag throw) by moderately and severely mentally retarded subjects. Randomly selected non-handicapped subjects from Corvallis Public School District 509J, Corvallis, Oregon, constituted a control group. Moderately and severely mentally retarded volunteers were randomly selected from Fairview Training Center in Salem, Oregon. The subjects were randomly assigned to one of three treatment groups: 2, 3, or 4 TTC. The subjects were introduced to a discrete motor task and continued to practice the skill until they met the designated learning criterion. Once they achieved their criterion level, the retention interval began and continued for 28 days. At the end of the retention interval, the subjects were administered the posttest, which consisted of two consecutive correct attempts to reach criterion. If the criterion was successfully reached, data collection were concluded. If not, one-to-one instruction was provided until two consecutive correct throws were achieved.

The experimental design of the research was a 3×3 (Level of Retardation \times Trials-to-Criterion) generalized, randomized block ANCOVA design with level of retardation as a blocking variable and the pretest as the

covariate. The dependent variable was the posttest score, consisting of the number of attempts to reach two consecutive correct trials.

The first null hypothesis, that there is no relationship between the covariate (pretest) and the dependent variable (posttest score), was rejected. The data indicated that scores did improve and that posttest scores did decrease. Further analysis was needed to determine where the differences existed.

The results of the investigation indicate that those treatment groups which experienced higher degrees of TTC had better retention scores. This information is useful to the classroom teacher interested in the most effective way to improve the retention capabilities of the mentally retarded student. Further analysis was necessary to determine which TTC treatment was the most effective.

The TTC treatment groups' overall adjusted posttest mean scores decreased as the performance criterion increased. This finding suggests that if teachers increase the performance criterion, mentally retarded students may improve their ability to retain a motor skill. The findings of Ammons (1958), Chasey (1971; 1977), Chasey & Knowles (1973), Heber, Prehm, Nardi, and Simpson (1962), Lance, (1965), Melnick, (1971), and Delmore (1975) suggest that mentally retarded subjects do respond favorably to increased TTC and overlearning. These data suggest that there are differences among the three levels of TTC and that it is worthy of the teacher's attention.

The null hypothesis, that there is no treatment effect for retardation, was retained and considered as a tenable statement. The high degree of variability within groups of mentally retarded subjects makes it difficult to establish specific trends for any one level of retardation. Some subjects appear to have the capacity to throw an object but may not be developmen-

tally ready to perform a specific motor task (Robinson & Robinson, 1976). This is an important finding, even though the findings were not statistically significant.

The fourth null hypothesis, that there is no significant interaction effect between trials-to-criterion and retardation, was rejected. Interaction did take place between the levels of retardation and TTC. The SMR two TTC group posttest mean score was significantly greater than all other posttest mean scores. This indicates that the SMR subjects may need a higher initial performance criterion. No apparent interaction took place between three and four TTC for the MMR and SMR groups. This may be accounted for by the high degree of variability within the various groups. For example, some severely mentally retarded subjects performed well and required fewer trials to reach criterion than did some of the moderately mentally retarded subjects.

However, the data indicate that for the SMR subjects, three and four TTC lead to improved retention. Although significance was not obtained with the MMR, a similar trend was evident, suggesting that two TTC may not be a viable criterion to use with the mentally retarded. The number of TTC appears to be particularly meaningful as the level of retardation becomes more severe.

All three groups experienced a decrease in the number of attempts required to reach each criterion level when the pretest means were compared to the posttest means. The MMR group took fewer attempts on the average to reach criterion on the posttest than did the SMR group. This was anticipated, since MMR subjects would generally be expected to perform better on the motor task.

All groups demonstrated a decrease in the number of attempts taken for the posttest when the pretest means were compared to the posttest means for the three TTC group. More attempts were needed to achieve the posttest criterion for the four TTC treatment group. This was expected, since four consecutive correct trials were more difficult to achieve than either three TTC or two TTC.

Implications

This study established that three and four TTC lead to better retention scores for a discrete motor task. The improvement in the students' abilities to retain the discrete motor task may be strongly related to the orderly, sequenced, instructional model used in the study. Several studies support the premise that an increased number of trials can positively influence a motor response. Using a target design with an audible signal may assist moderately and severely mentally retarded individuals in attending to the skill. Incorporating a positive learning environment may increase the subjects' desire to learn.

Teachers should use caution when incorporating two TTC into didactic instruction, since the amount of the motor skill retained may be diminished. Three TTC may be superior in practice to four TTC due to the increased amount of time needed to achieve criterion at four consecutive correct trials.

Recommendations

Increasing the body of knowledge relevant to the ways handicapped children retain material is vital if educators expect to develop the abilities of the moderately and severely mentally retarded to their fullest potential.

Expanding the range of applications of systemized instructional approaches may increase the degree of success of the student and motivate the teacher to continue the effort to maximize the ability to learn. The following research is recommended:

- 1) Replicate the present study using a sample from the public schools so the results could be generalized to that group.
- 2) Conduct a similar study using well-defined age groups, i.e., 6 to 9 years, 10 to 13 years, 14 to 17 years, and 18 to 21 years, to help reduce the potential confounding effect of age on the results.
- 3) Conduct a similar study in which subjects are exposed to all three TTC treatments across several skills.
- 4) Investigate the most effective number of trials to be used during one instructional period in order to achieve the optimal level of motivation and retention.
- 5) Determine which TTC treatment has the greatest effect on skills generalized to various learning environments.

The results of these studies could contribute to the effectiveness of motor programs for the moderately and severely mentally retarded subjects in public schools and institutions.

Conducting field based research presents continual challenges to those conducting the research. The following section is designed to share some of the insights gained during this study with others who study mentally retarded populations.

Two of the more difficult preliminary tasks completed prior to beginning the study were locating subjects and finalizing a workable schedule. Prior to contacting Fairview and the Corvallis Schools, the first three chap-

ters of this study were completed and approved, and problems in study design and methodology were resolved prior to presenting the project to personnel at the research sites. The research review board at Fairview consisted of five individuals who conduct research on a daily basis. Their questions concerned the degree of involvement by Fairview, the methodology of the study, and the safety of the students. When proposing the study, emphasis was placed on the value of this project to Fairview, its clients, and teachers. The board reacted very favorably to the project when they realized the potential benefit to their clients.

A request was made by the Fairview Administration to alter certain requirements which had been established by the researcher to insure consistency in the instructional environment. The effect of altering the learning environment could have been a much weaker study; however, further explanation of the strengths of the methodology, the importance of accurate results, and the potential impact on future physical education programs for the mentally retarded at Fairview was effective in negotiating an acceptable compromise regarding scheduling.

Stressing the importance of secondary returns strengthened the support for the study. For example, developing a closer working relationship between OSU and Fairview may facilitate planning of future workshops and seminars. Placing a trained professional with special clients, and running programs utilizing local aides and volunteers, may have a positive influence on general attitudes towards the mentally retarded and on the quality and quantity of instructional effort offered these students.

Maintaining consistent schedules was crucial when working with the teachers. They tended to feel intruded upon if the established schedule was not kept. It was helpful to be tolerant of the teachers' failure to follow the

schedule, and open lines of communication were essential when discussing potential problems. Conducting any type of research and infringing upon the normal classroom pattern may be inconvenient and cause extra work for the teacher. Researchers should use every opportunity to reinforce teachers for their support of the project and for their effectiveness as teachers. Taking time to respond to the teachers' smallest concerns and maintaining a sincere interest in their daily challenges is a solid investment for the researcher.

The final note concerns the roles of OSU, Fairview, and Corvallis public schools in the study. The responsibilities of each party were delineated and agreed upon prior to the commencement of the study. Because the chain of command was previously established, communication and interaction were enhanced. At the conclusion of each pre-study meeting, a written record of issues discussed and decisions taken was made for future reference during the actual research process. The circulation of memos restating and reviewing group decisions helped to identify and rectify possible misunderstandings.

The degree of coordination achieved for this study reinforces the concept that research endeavor is valuable, not only because it suggests answers to theoretical questions, but because it constitutes a rich source of information about the process of effectively finding those answers.

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APPENDICES

Appendix A

Task Analysis

SKILL: Overhead Beanbag Throw

TERMINAL OBJECTIVE: The student from a standing position facing the target will throw the beanbag overhand, hitting the target from a distance of 10 feet.

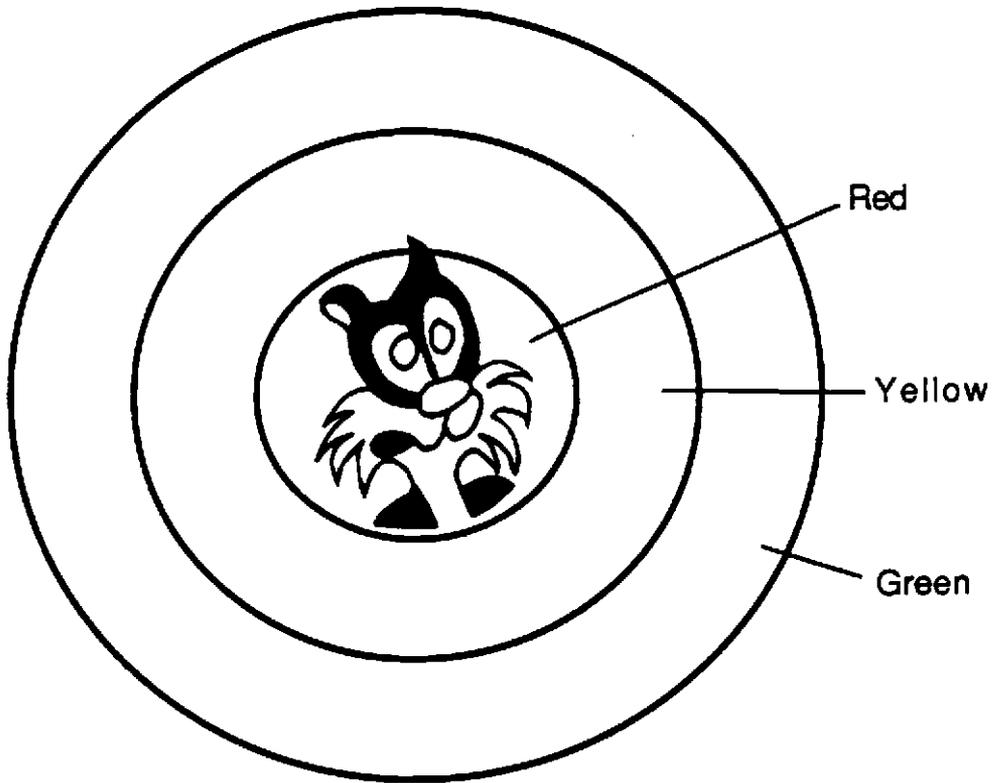
PREREQUISITE SKILLS: Grasping reflex, overhand throw, and standing

PHASE I: Assuming the ready position, the student will grasp the beanbag and toss it overhand.

PHASE II: Assuming the ready position, the student will grasp the beanbag, throw it ten feet and hit the target.

- STEPS:**
1. Two feet
 2. Four feet
 3. Six feet
 4. Eight feet
 5. Ten feet

Appendix B
Target Design



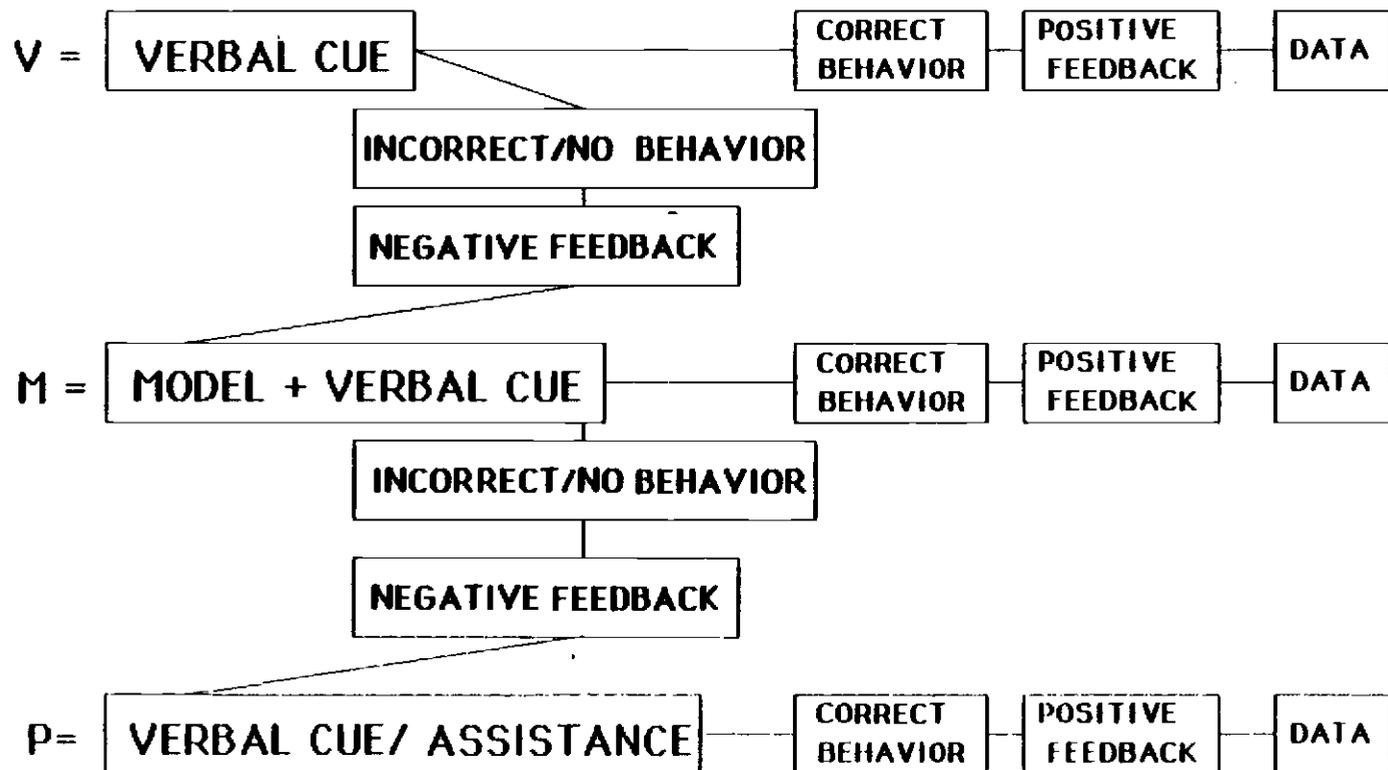
Schematic Drawing of Target Used
in the Throwing Test

Appendix C

1:1 Instruction Flow Chart

A DATA BASED GYMNASIUM

DEVELOPED BY
OREGON STATE UNIVERSITY/TEACHING RESEARCH



Appendix D

Data Sheet

Appendix E
Interaction Data

COMPARISON OF ADJUSTED POSTTEST MEANS

GROUP	CRITERIA	ADJUSTED POSTTEST MEANS	RANK ORDER	CRITICAL VALUE
MODERATE	4	5.53	1	
MODERATE	3	5.57	2	11.72
SEVERE	3	8.08	3	14.19
NORMAL	4	8.25	4	15.57
SEVERE	4	8.38	5	16.57
NORMAL	2	8.76	6	17.33
NORMAL	3	9.27	7	17.95
MODERATE	2	20.28	8	18.46
SEVERE	2	36.13	9	18.92

Appendix F

Human Subjects Committee Form

OREGON STATE UNIVERSITY

Committee for the Protection of Human Subjects

Chairman's Summary of Review

Title: The Effect of Trials-to-Criterion on the Retention of a Discrete
Motor Skill by Moderately and Severely Mentally Retarded Individuals

Program Director: John M. Dunn

Recommendation:

- | | |
|--|--|
| <input type="checkbox"/> Approval* | * The informed consent forms obtained from each subject need to be retained for the long term. Archives Division of the OSU Department of Budgets and Personnel Service is willing to receive and archive these on microfilm. At present at least, this can be done without charge to the research project. Please have the forms retained in archives as well as in your files. |
| <input checked="" type="checkbox"/> Provisional Approval | |
| <input type="checkbox"/> Disapproval | |
| <input type="checkbox"/> No action | |

Remarks Please revise the informed consent statement to include: 1) that the
subject is free to withdraw from the experiment at any time; and 2) that
test scores will remain confidential. A code number frequently is employed
in many studies of this kind to assure anonymity.

Redacted for Privacy

Date: June 10, 1986

Signature →

Robert Mason

If the recommendation of the committee is for provisional approval or disapproval, the program director should resubmit the application with the necessary corrections within one month.

JUN 12 1986

Appendix G

Parental Consent Form

The Department of
Physical Education



Corvallis, Oregon 97331-3302

CONSENT FORM

Participant's Name _____

Description of the Study

The purpose of this study is to examine the effects of various trials to criterion on retention of a gross motor skill, the overhand throw, with individuals who are mentally retarded and living at Fairview Training Center, Salem, Oregon.

The skill of performing the overhand throw is broken down into enabling behaviors or more simplified forms of the overhand throw. The subjects will begin instruction at their entry level and will progress to more difficult motor behaviors listed in the overhand throw task analysis when the learning criterion has been met.

The subjects will be divide into three groups. Everyone will work on the overhand throw until they meet the learning criterion of two consecutive correct throws. The first group will not practice the skill any longer and wait twenty-eight days before they attempt to perform the skill three times in a row; while the third group will practice until they can complete the skill four times in a row. When the learning criterion has been met they will wait twenty-eight days and relearn the skill. The amount of retention will be measured by how quickly the students relearn the skill. Understanding which learning criterion provides the best retention maximizes the student's potential for improvement and may facilitate the development of motor skills for all special students.

This is to certify that I agree to allow my student to participate in this study. I understand the purpose of the research. I further understand that if I have any questions they will be answered by the researcher in person or by mail:

Jim W. Morehouse, JR.
Department of Physical Education
Oregon State University
Corvallis, OR 97331
(503) 754-3719

I hereby give my consent for _____ to participate in the study. I reserve the right to withdraw my consent and discontinue participation at any time.

Parent/Guardian's Signature

Printed Name

Date