ABSTRACT

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This study compared two methods for teaching 3-ball juggling to college students. Subjects (Ss) were students enrolled in introductory Physical Education courses at the University of Wisconsin-La Crosse (N = 46), and were divided into 2 experimental groups. Both groups participated in 2 15-min juggling lessons. The "wall practice" group juggled while facing a blank wall at a distance of 2 ft. The "nonwall" group juggled while facing a blank wall at a distance of 12 ft. Subjects were tested on 3 occasions: prior to the treatment (pretest), after the treatment (posttest), and following a 1-week interval during which no juggling practice was permitted (retention). A 2-way test of independent samples revealed no significant difference between groups in the pretest ($p > .05$). A 2-way ANOVA with repeated measures revealed that Ss improved significantly from posttest to retention ($p < .05$), although improvement was regardless of treatment group. A 2-way ANCOVA determined that the groups' posttest scores were not significantly different ($p > .05$). It was concluded that wall practice was neither a help nor a hindrance to juggling skill acquisition. Several Ss in the wall group remarked that they felt dependent upon the wall for optimal performance, but the results did not reveal any differences between treatments.

A COMPARISON OF TWO METHODS FOR TEACHING THREE-BALL JUGGLING

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Finally, I dedicate this project to all the people in high school who said, "What do you think you are going to do - juggle for the rest of your life?!"

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

Background

Juggling has become increasingly popular in school Physical Education (PE) programs and as a leisure activity. Yet juggling has not been the subject of much formal research. Although a good deal is known about the physics of juggling, there has been surprisingly little investigation of appropriate pedagogical techniques for the skill. This study will compare two common teaching methods for three-ball juggling.

History of Juggling

Juggling has long been a part of human history. Egyptian hieroglyphics depict women juggling with balls (Summers, 1990). The modern circus has its roots in the ancient Roman games. Accounts of jugglers during the Middle Ages have been well documented (Cohen, 1982). More recently, juggling took its place as a staple of the Vaudeville stage, street performances, and the modern American circus. Juggling acts in Soviet and Asian circuses have descended from a long tradition which continues to the present day.

In more recent years juggling has grown from being the provincial territory of professional entertainers into a leisure activity enjoyed by many. The International Jugglers' Association was founded in 1947 to further the development and understanding

of the activity, and to provide a means for jugglers to share ideas and information with one another (Juggling Information Service, [On-line], 1997).

Perceived Benefits of Juggling

Many authors have proposed numerous possible benefits from juggling. Cohen (1982) suggested that juggling may facilitate the development of coordination, concentration, and self-control, and that it may enhance the five bodily senses.

In The Complete Juggler, Finnigan (1987) listed numerous possible uses of juggling. He believes the task reinforces persistence during practice, and has proposed the use of juggling as a neuromotor diagnostic tool and therapy. Finnigan also suggested that juggling may develop ambidexterity, as well as improve reflexes, visual tracking skills, concentration, fine and gross motor skills, and rhythm.

Benge (1984) advocated the use of juggling as a noncompetitive alternative to traditional sports. Gelb and Buzan (1994) used juggling as a metaphor for several aspects of life, including mind-body awareness. Some practitioners have suggested to the present author that juggling may influence reading ability because of similarities in eye movements in both skills.

In it's Guide to Content and Assessment, the National Association for Sport and Physical Education (NASPE, 1995) included seven standards which define a physically educated person. The seventh standard states that a physically educated person, "Understands that physical activity provides opportunities for enjoyment, challenge, self-expression, and social interaction." Juggling satisfies each of the focus points

contained in this standard. Students almost always appear to enjoy the act and challenge of juggling. Students often find juggling to be a conduit for self-expression as they become more proficient in the skill. Juggling also provides opportunities for social interaction through comparison of skills and tricks, and partner and group juggling.

Juggling in Education

Schools have made use of juggling in a number of ways. Juggling is often taught as a PE or interdisciplinary unit. Some schools even put on student circuses. Classroom teachers have made use of juggling as a "rainy day" activity both in the classroom and at recess. Juggling with lightweight scarves is especially popular in the classroom due to safety concerns, and because it can be done at students' desks.

Culminating Event Programs

An increasingly popular project is the presentation of a student circus. This can be the undertaking of a single class, a grade level, a student interest group, or an entire school. Mohnsen (1997) pointed out that culminating event programs in which students perform circus skills for an audience can be considered authentic assessments.

Culminating event programs often involve teachers from different disciplines who become responsible for a particular facet of the performance. For example, an art teacher may design costuming, scenery, and makeup. A PE teacher may be responsible for skill development. A music teacher can organize a "clown chorus" or a circus band. In this way, circus programs are often interdisciplinary.

During preparation for culminating event programs, classroom teachers often incorporate circus themes into their curriculum. The history of the circus in America or other countries can be explored. The physics of aerial stunts can be used as examples in science. Music teachers can introduce their classes to traditional circus music, such as from a "calliope", or steam organ.

Several organizations exist for the purpose of facilitating school juggling and circus programs. These include the New York-based National Circus Project, and Jugglebug Inc. in the state of Washington.

Formal Research

Despite the growing popularity of juggling and circus arts as educational activities, and the many benefits claimed by juggling enthusiasts, very little formal research on the subject has been undertaken. Although numerous researchers have used juggling as a novel task in their investigations of other phenomena (Breen, 1983; Bush, 1961; Cugini, 1959; Meaney, 1994; Murray, 1978; Solmon, 1996), there has been little work on teaching strategies designed specifically for juggling.

Researchers in the field of motor behavior have made the most extensive use of juggling (Beek & Turvey, 1992; Beek & van Santvoord, 1992; Bush, 1961; Gallagher, 1961; Hautala, 1985, 1988). Three-ball or modified juggling has been a frequent tool, usually as a novel task, in investigations of how humans plan and control movements.

Purpose of Study

During their initial forays into three-object juggling, many beginners find themselves running about the practice area as they attempt to keep their balls or beanbags aloft. In effect, the learner chases after the balls, being unable to juggle them while remaining in a stationary position. This is a problem which Lewis (1974) has called "drift", and it is addressed in most books about juggling. Many books recommend that the learner remedy this problem by practicing their juggling in front of a wall (Besmehn, 1994; Bolton, 1982; Cassidy & Rimbeaux, 1977; Gelb & Buzan, 1994; Gifford, 1995; Lewis, 1974; Summers, 1990). This activity will here be called "wall practice". Other books recommend different remedial techniques (Benge, 1984; Burgess, 1989; Cohen, 1982; Fife, 1987; Finnigan, 1987; Wiley, 1985).

The primary purpose of this study was two compare the effects of learning to juggle three balls using wall practice to an alternate teaching methodology in which the learner practices in an open space. The secondary purpose of this study was to determine if significant learning took place for students who used either technique.

Hypotheses

The hypotheses for this study are:

1. There will be no significant difference between students who utilized wall practice in the early stages of learning to juggle as compared to students who always practiced in an open space.
2. There will be no significant learning effect for either experimental group.

Assumption

It was assumed that all subjects made their best effort during the practice and testing phases of the experiment.

Limitations

1. Although the subjects were requested to refrain from juggling outside of the experimental protocols, verification of their complicity with this instruction was not feasible.
2. Although prior research has suggested that balls which bounce detract from the amount of practice time available to novice jugglers (Hautala, 1988), beanbags or similar equipment were not available for the present investigation. Instead, the subjects used tennis balls.
3. Although two teaching methods were compared in this study, compelling logistical concerns made it necessary to utilize an extra group of students. There was a lower student enrollment in the Circus Arts class which comprised the wall practice group than in the class which made up the nonwall group. To equalize the number of subjects in each treatment group, a third pool of subjects was enlisted in the experiment as a second wall practice group. The two wall practice groups were put through identical experimental procedures, and were therefore treated as one group for purposes of statistical analysis.

Delimitation

Of the subjects in this study, 33 were college students enrolled in a one-credit circus arts course at the University of Wisconsin-La Crosse. The remaining 13 subjects were drawn from a one-credit rock climbing course at the same institution.

Definition of Terms

Basic Cascade - the simplest and most common pattern for juggling three objects with two hands. Each object is thrown and subsequently caught by the other hand. Objects are thrown with an angle of release less than 90° relative to an incoming object approaching the same hand. The resulting parabolic trajectories resemble an infinity sign (∞).

Drift - a term coined by Lewis (1974) to describe the tendency of novice jugglers to chase after their juggling objects due to an inability to continue performing the skill in a stationary position.

Juggling - the act of continuously throwing and catching more objects than the number of hands being utilized for the task.

Time-on-Task - the amount of class time in which students are engaged in meaningful practice of a skill or activity (Rink, 1993).

Wall Practice - the act of practicing juggling or its intermediate steps while standing close to and facing a wall, usually using balls or similar objects.

The "X" - an intermediate step in learning to juggle, using two objects. The first object is tossed to approximately head height. When it reaches its peak, the second object is thrown such that it crosses the first ball in the air. The resulting trajectories describe an X. The objects may or may not be caught during the execution of this skill.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

In this chapter literature is reviewed pertaining to learning strategies and motor control issues which relate to juggling. Most books about juggling are entirely self-pedagogical. That is, such books are intended to help the reader teach oneself how to juggle. Few books on juggling discuss instructional strategies for teaching the activity to others. None of the books utilized in the present study mention formal research to support the self-instructional strategies they advocate.

A number of research experiments have utilized juggling as a novel task in the investigation of other phenomena or theories. However, there is a paucity of formal research on juggling per se, or on learning strategies designed specifically for juggling.

In addition to examining purely juggling related research, this chapter addresses issues pertinent to effective pedagogical technique in general. Juggling can be classified as a continuous motor skill, and teaching techniques and practice regimens exist for effective instruction of skills in this category. Other pedagogical subjects reviewed are the impact of modeling, time-on-task, cognitive cues, and progressions.

Motor behavioral research has produced the most comprehensive description of juggling as a task, chiefly within the framework of the Dynamical Systems, or Ecological

approach, to human motor control. A brief review of this research will serve to characterize and define juggling as a skill before delving into issues relating to teaching.

Defining the Juggling "Work Space"

Juggling is an attractive and convenient skill for researchers investigating a Dynamical Systems Theory of human motor control. First, it is a continuous skill in which the arm movements constitute a system of nonlinear oscillators. Second, the severe spatiotemporal constraints governing juggling have been carefully quantified (Beek, 1989). In effect, the *end state* of the correctly performed task has been identified. This has enabled researchers to examine the stages through which beginning jugglers progress while learning the skill (Beek & van Santvoord, 1992). Third, although juggling is highly rhythmic, humans characteristically perform it with variability (Beek, 1989). This is of interest to theorists concerned with how, and to what extent, the human motor control system permits and even seeks variation in highly repetitive tasks.

The task constraints in juggling are severe, and can be roughly summarized as the necessity of coordinating cyclic hand and ball movements within a fixed gravitational gradient. After observing beginning jugglers, Beek and van Santvoord (1992) proposed a three-stage progression of learning for the task. Stage one has the learner beginning to cope with the "real time" requirements of juggling. These requirements relate to the proportional timing of ball and hand movements which must be satisfied in order to achieve true cascade juggling. Having satisfied the basic requirements necessary to make the skill physically possible, learners in the second stage move toward a more desirable

and stable state with regard to the temporal aspects of hand movements. Achievement of this preferred "mode locking" in stage two enables the juggler to sustain a three-ball cascade, albeit with little room for error. Finally, in stage three the juggler learns to diverge from the preferred mode-locking state of hand movements, thereby supporting the claim that humans have a predilection for variability in the performance of continuous physical skills.

Beek and van Santvoord believe that divergence and modulation from the optimal temporal patterns in stage three characterizes skillful execution of the skill. They are supported in this conclusion by a separate study authored by Beek and Turvey (1992) in which expert jugglers tended to perform near and around the optimal mode locking state rather than exhibiting rigid adherence thereto. This preference for variability was referred to as juggling with "flair" (Beek & van Santvoord, 1992). Beek (1989) has speculated that preference for such excursions from an optimal state may be a common trait of skilled biological systems, and may represent the predilection of such systems toward stable, yet flexible performance.

The "Drift" Problem

A common problem experienced by novice jugglers is the onset of unintentional locomotor movement in response to errant throws. This is a tendency which Lewis (1974) has called "drift". Beginning jugglers often impart an undesirable horizontal impetus to their juggling objects, thus necessitating forward locomotor movement in order to catch. Indeed, novice jugglers can often be seen charging about the practice area in pursuit of

their juggling balls. Every book utilized in the present study makes mention of this tendency. Many books advise the use of a wall as a technique for defeating drift (Besmehn, 1994; Bolton, 1982; Cassidy & Rimbeaux, 1977; Gelb & Buzan, 1994; Gifford, 1995; Lewis, 1974; Summers, 1990), while some do not (Benge, 1984; Burgess, 1989; Cohen, 1982; Fife, 1987; Finnigan, 1987; Wiley, 1985).

Wall Practice as a Solution for Drift

Besmehn (1994) advises the novice juggler that the skill is "two-dimensional" - throws should have height and width, but not depth. Drift represents the learner's inability to successfully cope with this aspect of the task. Many books advocate the use of a wall as a remedial technique for preventing drift, an activity that will here be called "wall practice". This technique has the student standing close to, and facing, a wall while juggling. It is apparently presumed that wall practice will assist the juggler in two ways. First, any throws with an undesirable horizontal component will be rebounded by the wall back to the juggler. Second, the wall will prevent the juggler from moving forward. Proponents of wall practice seem to feel that either or both of these effects will eventually train the beginning juggler to throw the balls upward rather than forward.

To implement wall practice, Besmehn advises the learner to stand about an arm's length from a wall while practicing. Other books such as those by Lewis (1974), Summers (1990), Gelb and Buzan (1994), and the popular Juggling for the Complete Klutz (Cassidy & Rimbeaux, 1977) all make similar recommendations for using wall practice as a remedial technique to combat drift. Interestingly, the only book found to

offer substantial pedagogical strategies for teaching juggling (Finnigan, 1987) addresses drift, but wall practice is not one of the strategies listed to help solve the problem.

A search of the Internet revealed numerous sources for information about juggling. A large clearinghouse for such information is the Juggling Information Service (Juggling Information Service [On-Line], 1997), which contains a searchable database of user comments and dialogues. Using the search term "Wall", 747 total matches were found, of which 26 were references to wall practice. Of these, 22 favored its use, two were opposed, and two gave suggestions for modified versions of wall practice. One of the modifications involved juggling while facing a corner rather than a wall. The other was to slow the return of the balls to the hands by allowing them to roll down an inclined board. The latter idea is an intriguing alternative to the well known technique of juggling scarves in order to slow down the task.

Other Solutions for Drift

The books which do not recommend wall practice (Benge, 1984; Burgess, 1989; Cohen, 1982; Fife, 1987; Finnigan, 1987; Wiley, 1985) do mention drift. These authors have offered other solutions for drift, and these can be grouped into two main classifications: A. Cognitive cues and B. Modified activities, or lead-ups. With each solution it is also possible to synthesize potentially useful approaches from PE pedagogical technique.

Cognitive Cues

Teachers of juggling often use cognitive cues to assist learners in understanding the skill, and to facilitate more correct performance. Cues for novice jugglers include the following:

1. Remind the student that balls thrown from each hand should reach the same respective points in space at their peaks (Benge, 1982; Finnigan, 1987).
2. Direct the student to pay special attention to a particular throw on their next attempt(s) to guard against throwing forward (Finnigan, 1987).
3. Remind the student that juggling takes place in a vertical plane in front of the body, and to attempt to throw upward rather than outward (Finnigan, 1987).

Skill Modifications and Lead-Ups

The second class of remedial techniques involves directing the student to practice the skill in a modified fashion. These strategies include the following:

1. Direct the student to stand on a line or spot on the floor and practice juggling without moving his or her feet from the line (Finnigan, 1987).
2. Direct the student to kneel down for a series of practice attempts.
3. Direct the student to practice while standing in front of a bed or similar low object (Cohen, 1982).
4. Count throws with the student while he juggles and direct the student to stop when he reaches the throw which is most often thrown with forward motion (Finnigan, 1987).

5. Advise the student to throw higher than usual in order to gain more time and eliminate the necessity of throwing forward.
6. Direct the student to make three throws without catching the balls and then examine where the objects landed to check for forward motion.
7. Any of the above steps, including verbal cues, but with the student using only two juggling objects.
8. Have the student walk backwards while juggling (Bolton, 1982).

Possible Advantages and Disadvantages of Wall Practice

Use of the wall may be viewed as a forced corrective measure, or as an environmental constraint. When viewed from either perspective, there is theoretical evidence both for and against the use of wall practice as a solution for drift.

Possible Disadvantage of Forcing "Correct" Technique on the Learner

Wall practice as a remedial technique may differ from other traditional skill modifications or lead-ups in that it attempts to "force" a correct behavior on the learner rather than helping the learner correct the problem intrinsically. There is some evidence that forcing correct behaviors on beginning jugglers may not be conducive to learning.

Bush (1961) equipped novice jugglers with blinders which limited their field of vision to the area believed to be most important for the task of ball juggling, as proposed in prior research (Gallagher, 1961). This approach did not yield significant gains in learning for the majority of subjects. Based on these findings, Bush speculated that the

most important aspects of learning to juggle are determination and practice, rather than attention to hypothetically "correct" visual information.

In their investigations of the stages through which beginning jugglers progress, Beek and van Santvoord (1992) found evidence to support the idea that the primary task for the beginning juggler is to adapt to the temporal constraints of the activity. In the hope of assisting subjects in this effort, the authors provided a metronome to set an appropriate tempo for three-ball juggling. Here again is an example of an attempt to force a correct behavior, in this case the rhythm, onto the beginning juggler. Perhaps not surprisingly, the metronome was of no assistance to novice jugglers learning to keep three balls aloft.

Possible Disadvantage of Eliminating Errors

Bush (1961) noted that attempting to force a correct behavior on the subjects in her study may have deprived them of the chance to learn from their errors. Deriving information from the identification and correction of errors can be valuable to learners, although the ability to do so is thought to be characteristic of autonomous performance of a skill (Magill, 1993). If wall practice does in fact force a correct behavior on the learner, it is possible that the learner will not benefit from detection and correction of common errors made during the learning process.

In the present study, the use of wall practice may represent a modification of the errors normally committed in juggling. Any balls thrown with a component of horizontal motion will be rebounded by the wall. Practice away from the wall would cause such throws to be chased and very likely dropped. Balls rebounded by the wall may be less

informative feedback to beginning jugglers than dropped balls. From the standpoint of behavioral psychology, rebounded balls may be a less powerful reinforcer for executing the correct behavior. Because a rebounded ball would likely cause less anxiety for a learner than a dropped ball, the learner may have less incentive to correct the problem.

Since error detection and correction are behaviors thought to be typical of learners approaching autonomous execution of the skill, it may be expected that both the wall and nonwall groups will progress equally effectively in their respective environments at earlier stages of learning. However, the post and retention tests will require the subjects to perform the skill without the benefit of the wall for error detection.

Possible Disadvantage of a Dependency Effect

According to Schmidt (1988), it is beneficial to practice skills in variable environments and conditions in order to increase the likelihood of optimal performance in unknown future situations. Skill performance, even when the skill can be performed well under constant conditions, is likely to suffer when the skill must be executed under unfamiliar conditions. In such a circumstance, the performer can be said to be dependent upon familiar surroundings.

Although open skills are more susceptible to this type of dependency, it has been the present author's experience that it is a factor in the performance of juggling. Professional jugglers are often called upon to execute their skills in unfamiliar and widely varying environments. For this reason, professionals often deliberately vary the environmental conditions of their practice site. For example, a juggler who frequently

practices in the same gymnasium might choose to face a different direction in each session, or to vary the lighting conditions in the room. This control of the practice area constitutes safeguarding against becoming dependent upon consistent conditions.

It is possible that wall practice could create a dependency effect for novice jugglers. In the present study, one group of subjects always used wall practice, while the other always practiced while standing on a tape line facing a wall from a distance. Each group was tested while standing inside a hoop placed near the center of the room. A wall practice dependency effect may be in evidence if the wall practice group completes significantly less consecutive catches than the nonwall group.

Possible Advantage as a Form of Augmented Feedback

To account for the ineffectiveness of a metronome's beep as an aid to beginning jugglers, Beek and van Santvoord (1992) speculated that juggling may be a very closed skill into which it is difficult to introduce an effective feedback device. This may be a situation similar to when teachers attempt to give cognitive cues to a student in the midst of performance. This is essentially an attempt by the teacher to "penetrate" the task in question. The present author's experience has been that most beginning jugglers are unable to effectively respond to commands such as "Throw now!" in the midst of an attempt. Such failure may represent unsuccessful or insufficient penetration of the juggling work space similar to Beek and van Santvoord's attempt with the metronome.

In the same sense that Beek and van Santvoord considered their metronome inadequate for providing feedback to the learner, the use of the wall to remedy drift may

prove to be similarly ineffective. However, wall practice may have two advantages over the metronome. First, feedback gleaned from the wall in the form of rebounding objects is the direct result of activity from *within* the juggling work space. Therefore, wall practice might not represent feedback from a foreign source, but rather from within the task itself. Second, through the examination of ensemble variables, Beek and van Santvoord found evidence to support the idea that spatial, rather than temporal, feedback may be more useful to jugglers during the learning process. Although Beek and van Santvoord were probably referring to a variable throw-height criterion, it is possible that a horizontal displacement criterion in the form of a wall could also be effective.

Possible Advantage as a Lead-Up Skill

Wall practice may indeed be helpful to novice jugglers as a lead-up skill. Use of the wall may allow beginning jugglers to concentrate on the timing aspects of juggling without having to focus on throw displacement. For novices who experience drift, wall practice may help in training them to throw with more correct form.

Other Issues Affecting Learning Outcomes in Juggling

Many issues pertinent to pedagogical technique will naturally influence student learning. This section will discuss such concerns in relation to the present study.

Time-On-Task and Learning Transfer vs. Task Specificity

In the first section of The Complete Juggler (Finnigan, 1987) the reader is advised to follow the book's progression without skipping steps. The book's first instructional segment is about scarf juggling. Finnigan has long advocated the use of lightweight

juggling scarves as a lead-up activity for ball or beanbag juggling. The foundation of this strategy is that the slow moving scarves will permit easier learning of the skill than the considerably faster balls. Implicit in this assumption is the idea that a transfer of learning will take place between scarf and ball juggling. As logical as this assumption may seem, there is evidence that juggling may be subject to considerable task specificity, and that learning transfer is not superior to practice of the ultimately desired skill in its final form.

Hautala (1985, 1988) studied the effects of learning transfer in juggling. Drawing on instructional sequences from Finnigan, subjects learned to juggle using scarves, weighted scarves, beanbags, balls, or a combination thereof (Hautala, 1988). At the conclusion of three weeks of practice all subjects were tested for ball juggling skills to determine the amount of learning transfer. The results showed that subjects who practiced with beanbags performed significantly better than those who practiced with scarves, balls, or a progression of practice which involved the use of each piece of equipment. Hautala concluded that a transfer effect did take place from scarf to ball juggling, but that scarf juggling did not represent a superior learning strategy to juggling only with balls. Instead, time spent in practice with beanbags or balls appeared to be the more important factor in learning, probably because they represented a more correct version of the final skill. Hautala also reported that this finding was in accord with research on teacher effectiveness and student learning outcomes which has indicated that time spent in practice of the targeted skill, or lead-ups with "identical" elements, has the most significant impact on learning. The time-on-task argument is also supported by Hautala's

observation that the ball jugglers in the experiment appeared to lose a large amount of practice time from having to chase after dropped balls. The beanbag group, which performed better, was probably able to maximize their practice time because their equipment did not roll or bounce away when dropped.

Pursuant to their investigations of a Dynamical Systems Theory for human motor control, Beek and Turvey (1992) examined the temporal differences between scarf and ball juggling. Three skilled jugglers were asked to juggle scarves at high, low, and medium frequencies. The results showed that the timing constraints of scarf juggling are less severe than ball juggling. Although all three-object juggling must ultimately conform to the timing requirements described by Shannon's Equation (Beek & van Santvoord, 1992), scarves appear to be less predictable in terms of timing due to their aerodynamic properties. In this sense, scarf juggling does not contain identical elements to ball juggling, but rather, its relative slowness appears to "dilute" the skill.

In summary, scarf juggling does satisfy the macroscopic timing requirements of three-object juggling, although the less severe "real time" constraints are likely to render scarf juggling ineffectual as a lead-up skill for the ultimate goal of ball juggling. The slow moving nature of the scarves makes them an unlikely aid to learners attempting to satisfy the more difficult timing requirements of ball juggling. It appears likely that skill acquisition in ball juggling will be best facilitated through practice with balls or beanbags, rather than with other equipment.

Progressions and Sequences for Learning Ball Juggling

Having established that a person who intends to learn ball juggling should practice with balls rather than scarves, this section will examine different methods for structuring this practice. This section will draw upon pedagogical and motor behavioral research, and from popular books about juggling.

Knapp and Dixon (1950, 1952) and Knapp, Dixon, and Lazier (1958) conducted some of the only formal research which investigated pedagogical methods for juggling. In the first article of their series Knapp and Dixon (1950) identified seven variables which are likely to influence the benefits derived from practice. These included the distribution of practice and rest time, relative speed of the motions during practice, learner characteristics, and practice method.

In their second article, Knapp and Dixon (1952) compared part vs. whole learning for facilitating ball juggling skill acquisition in college males. They found that groups using a whole practice method reached a criterion goal of 100 consecutive catches with three balls in less time than groups using a part method or a combination part-whole method. However, this conclusion can be questioned on the grounds of statistical significance, and for the teaching progression used in the part section of the experiment.

The data in this study were divided into two functional groupings for statistical analysis. One group's results were significant only at the $p < .10$ level, the other at the $p < .30$ level. These low alpha levels make a Type I error more likely. In addition, there was a high degree of intersubject variability in learning time. These factors may indicate less of

an effect for part vs. whole practice than Knapp and Dixon have claimed. Rather, the high intersubject variability suggests individual learner characteristics may be the more important factor in learning three-ball juggling.

Second, the teaching progressions utilized in the part practice section were of questionable value in comparison to the methods in the whole practice section. The part practice directions called for the subjects to practice cyclic hand and arm motions to simulate juggling, throw one ball from hand to hand, toss two balls from hand to hand, and finally practice with three balls. Not all practice sessions followed exactly the same schedule, but all involved some combination of each of these steps. The problem with this progression is that most of the lead-up activities do not address the significant aspects of the juggling work space as defined by Beek and van Santvoord (1992). Practice of rhythmic hand and arm motions without balls is unlikely to simulate the rigid timing constraints of three ball juggling. Practice with one ball is unlikely to be of value for the same reason. Although some practice of the actual throw and catch might be helpful to younger subjects, it is likely that the male PE majors utilized as subjects already possessed ball handling skills adequate to the task of three ball juggling. The probable inefficacy of these two steps - arm movement without objects, and tossing and catching one object - makes it likely that subjects in the part practice groups were practicing irrelevant skills rather than crucial components of the juggling task.

It should be noted that throwing and catching one ball might be an important lead-up activity for young children, and for persons who have extremely limited experience

with ball skills. However, such practice would constitute a component of the juggling task only insofar as throwing, tracking, and catching one ball at a time. In and of themselves, these activities seem unlikely to address the more compelling temporal aspects of three-ball juggling.

A more appropriate lead-up to three-ball juggling might be using two balls to complete an "X". In this lead-up, one ball is thrown to a point slightly higher than the head. When it reaches its apex, the second ball is thrown such that its path will intersect that of the first ball. The resulting trajectories combine to describe an "X". Each ball is caught in the opposite hand from which it was thrown, although some juggling teachers will have learners execute this step with the catches omitted. Although Knapp and Dixon used this step as a component of the part practice instructions, the steps involving no balls and one ball obscure its effects.

In short, a replication of Knapp and Dixon's study might better illuminate the part vs. whole practice problem by eliminating unnecessary steps in the part practice section. Substituting the "X" and perhaps an intermediary step between the "X" and genuine three-ball practice, would create a learning progression which contains more correct and/or identical elements to three ball juggling.

Massed vs. Distributed Practice

Magill (1993) concluded in his motor behavior textbook that distributed practice is most effective for learning and retaining performance of continuous skills. That is, comparatively short bouts of practice produce more effective learning than do fewer bouts of long practice sessions.

Magill's conclusion is supported for the juggling task by the first article in Knapp and Dixon's (1950) series. In this study, two groups of male PE college students learned juggling by using either a massed or distributed practice regimen. The massed practice group practiced for 15 minutes on alternate days, while the distributed group practiced every day for 5 minutes. The subjects in the distributed group reached a criterion of 100 consecutive catches in significantly less time than the group using massed practice.

Due to logistical concerns, the current study's procedures more closely resembled a massed practice regimen. Although Knapp and Dixon (1950) showed that this method is not superior to distributed practice for juggling, consistent, if somewhat decreased performance can be expected from the subjects in the present study in comparison to learners using a more distributed work/rest regimen.

Motivational Climate

Learning outcomes in physical activities can be directly affected by the motivational climate of the learning environment. Solmon (1996) performed an experiment with junior high school students in which the motivational climate of their

classes was either "task involved" or "ego involved". Juggling was used as a novel task in the study.

In the task involved situation, the students were directed to focus on individual short-term goals and improvement to define success. The ego involved situation was structured around contests to determine the best juggler in the class, thereby defining success in relation to other students. The researcher did not track achievement in the juggling activity, but instead counted the number of practice attempts initiated by each student. A questionnaire was also administered which asked the students to identify what they felt contributed the most to success in the juggling activity - ability or practice? The students were also asked to identify the class in which they participated as task or ego involved.

At low levels of difficulty the groups did not significantly differ in the number of practice attempts initiated. However, at high levels of difficulty the students in the task involved classes initiated significantly more practice attempts per minute than did students in the ego involved classes. Students in the ego involved classes exhibited a greater tendency to attribute success to ability than did students in the task involved classes, although boys in either situation were more likely to make this attribution than girls. Students in the task involved classes were more likely to attribute success to practice.

Most students were able to accurately identify the ego or task focus of the class in which they participated. Solmon pointed to this finding as evidence that students are

aware of their motivational surroundings, and will react to whichever climate is prevalent in their learning environment.

The teachers of the different groups were interviewed at the completion of the experiment. The teachers felt that skilled students thrived in either situation, but that the ego involved climate presented more problems for less skillful students.

Solmon's findings are important for teachers of any physical skill, although it is convenient to the present study that Solmon used juggling as the task. The findings demonstrated that a class structured around task-oriented goals is more conducive to student practice and time-on-task. Since it has been established that practice time is a crucial factor in skill acquisition, this finding is particularly meaningful.

Ball and Background Color

There is evidence that ball color and the nature of the visual background against which a ball is viewed affects catching performance, at least in younger children. Morris (1974) found that when taken together as a single variable, ball and background color influence catching performance. A blue ball viewed against a white background produced the best results. It was therefore concluded that a high degree of contrast should be maintained between ball and background color to maximize performance of catching skills in young children.

Morris' findings suggest that the effects of ball and background color be controlled in the present study. This was accomplished by having subjects juggle green tennis balls against a light gray background.

Modeling

According to a review article by Gould and Roberts (1981), modeling occurs when a learner attempts to reproduce the performance of another person. Citing results from a study by Landers and Landers (1973), it was concluded that modeling is most effective when the demonstrator is skilled, and perceived to be of high status. A high status model in a school situation would be the teacher, rather than a student modeling a behavior.

Gould and Roberts (1981) also noted that tasks which can be broken down into small parts and presented in sequence lend themselves more readily to modeling. Juggling appears to fit this description, and it seems likely that the modeling component of the instructions to subjects is important. The present study employed a whole-part-whole demonstration technique presented by a skilled, high status model.

Goal Setting and Motivation

Anshel, Weinberg, and Jackson (1992) examined the effects of goal difficulty on learners' motivation levels. It was found that students who had been given comparatively high goals to achieve had more intrinsic motivation than students who were given easier goals. This finding contradicted the expectations of the authors, but does appear logical in context. By having a substantial and challenging goal to attain, students' interest and motivation appears to have been stimulated. The findings from Anshel, Weinberg, and Jackson's study are important to the present investigation. Considering that intersubject variability tends to be high in investigations of juggling (Beek & van Santvoord, 1992;

Knapp & Dixon, 1952), it is important to attempt to obtain reliable data. This may be facilitated by achieving a high degree of motivation for successful performance of the task. Therefore, during modeling of the juggling skill in the present study, the instructor directed all subjects to attempt to achieve a criterion of 30 consecutive catches by the end of the first day of practice. This is an ambitious goal, and hopefully increased the subjects' intrinsic motivation for the task.

Summary

Juggling is a continuous motor task in which the timing aspects are probably the most crucial concern for beginners. Drift is a common problem affecting many beginners, and wall practice is commonly recommended as a solution by books on the subject. Wall practice has the novice juggler practicing about an arm's length from a wall in order to minimize the effects of errant throws, and to prevent the learner from moving forward in pursuit of the juggling objects.

There are many alternatives to wall practice as a solution to the drift problem. These can be divided into two classes: cognitive cues and skill modifications or lead-ups.

Wall practice may have several advantages and disadvantages as a pedagogical aid. Possible disadvantages are that wall practice may constitute an attempt to force a correct behavior on learners, that it may create a dependency effect, and that it may deprive learners of the opportunity to gain information from the detection and correction of errors. Possible advantages of wall practice may be its use as a relevant form of augmented feedback, and as a lead-up or remedial step.

Many other issues may affect skill acquisition in three-ball juggling. These include the amount of time spent in meaningful practice, modeling of the skill, learning sequence, distribution of practice, ball and background color, goal setting and motivation, and the motivational climate of the learning environment.

CHAPTER III

METHODS AND PROCEDURES

Introduction

In order to compare the effects of wall practice and nonwall practice on the juggling performance of novices, 46 students at the University of Wisconsin-La Crosse took part in two juggling lessons. The subjects were tested on three occasions: prior to the juggling lessons (pretest), after the lessons (posttest), and after a one-week interval during which the subjects were asked to refrain from juggling (retention).

Subject Selection

Of the 46 subjects, 33 had enrolled in an introductory circus arts course, while the remaining 13 were drawn from students enrolled in an introductory rock climbing course. Using a coin flip, all subjects enrolled in the 9:55 a.m. circus arts class were designated the wall practice group, and all subjects enrolled in the 11:00 a.m. circus arts class were designated the nonwall group. The students from the rock climbing course were designated as a second wall practice group to equalize the number of subjects in each group.

Schedule of Experimental Procedures

Day 1

The purpose of the research was explained to all subjects, and informed consent forms (see Appendix A) were reviewed, signed, and collected. Each subject participated in the pretest, and the scores were written on Data Recording Sheets (see Appendix B). A lecture/demonstration of three-ball juggling (see Appendix C) was given by the principal investigator, followed by 15 minutes of practice. At the end of the session the subjects were instructed to avoid practice and mental rehearsal of the juggling task during the two-day interval prior to the next session.

Day 2

The instructor briefly reviewed instructions for learning to juggle, after which each group practiced for 15 minutes. At the conclusion of the practice session, all subjects participated in the posttest. The subjects were instructed to avoid practice and mental rehearsal of the juggling task during the week-long interval prior to the retention test.

Day 3

The third and final day of the experiment took place one week after day two. No instruction or review of the juggling task was presented. The investigator briefly reviewed the testing procedures, after which all subjects participated in the retention test. A debriefing was then conducted by the investigator in which the purpose of the research was explained, and subjects were given the opportunity to ask questions and comment on the experiment.

Instructional Sequence

The juggling instructions given to each group (see Appendix C) were identical, and both groups used the same practice location during their respective lessons. The only difference in treatment was the area of the room in which the subjects practiced. The wall practice group always practiced while standing on the tape lines which were placed 2 ft from the wall. The nonwall group was instructed to practice on tape lines which were placed 12 ft from the wall, and to face the wall while practicing. Each subject had their own tape line, and was instructed to initiate practice attempts at this location only.

Testing Procedures

The testing procedures in this study were modified versions of those used by Knapp and Dixon (1950). The same procedures were used in each phase of testing.

Location and Equipment

All subjects stood inside a 3 ft diameter hoop which was taped to the floor. The hoop was placed 15 ft from a blank wall. During testing each subject was asked to stand inside the hoop and face the wall. The purpose of this procedure was to assure uniform orientation of subjects to control the visual background against which the juggling objects were viewed. All subjects juggled with three tennis balls during testing.

Test Instructions to Subjects

Prior to the pretest the investigator demonstrated a three-ball cascade juggle, but did not give instructions or strategies for the task. The following test instructions were then read aloud to the subjects as a group: "You will have five attempts to juggle the three balls for as long as possible. You may begin each attempt when you are ready, but may not start an attempt over if you miss. You may take up to 10 seconds between each attempt, but may not practice between attempts. You may step on, but not out of the hoop. If you reach 30 consecutive catches during an attempt, that attempt is over."

Prior to the post and retention tests, the subjects were reminded of the test procedures. Although the juggling task was demonstrated prior to the pretest, it was not demonstrated again during the post and retention phases.

Scoring

During testing the principal investigator or a trained assistant knelt in front of the subject at a distance of approximately 10 feet to observe and record the number of consecutive catches made in each trial. The number of consecutive catches completed in the basic cascade in each trial was recorded on a Data Recording Sheet (see Appendix B). The maximum number of consecutive catches for a trial was 30. A catch was not counted, and the trial terminated when a subject:

1. dropped a ball.
2. stepped completely outside the hoop.
3. caught a ball with the same hand from which it was thrown.

4. threw a ball with a vertical angle of release greater than 90 degrees relative to an incoming ball to the same hand.
5. caught a ball with a body part other than the hands, or trapped a ball against their body.

Statistical Treatment

In addition to descriptive statistics, several statistical tools were employed to compare the two treatment groups and look for improvement in general. A two-way test of independent samples was used to determine if there was a significant difference between the groups' mean scores in the pretest. A two-way ANOVA with repeated measures was used to determine if there was a significant difference in overall scores from posttest to retention. A two-way ANCOVA was used to determine if the groups' scores in the posttest were significantly different.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purposes of this investigation were to compare two methods for teaching three-ball juggling, and determine if significant learning took place in the experimental groups. Two groups of subjects stood on tape lines while learning to juggle. The wall practice group's tape lines were placed at a distance of 2 ft from a blank wall. The nonwall group's tape lines were placed at a distance of 12 ft from a blank wall. Each group participated in two 15-minute juggling lessons. The subjects' juggling performance was tested at three times: prior to the treatment (pretest), after the treatment (posttest), and after a one-week interval during which no juggling practice was permitted (retention).

Subjects

A total of 46 subjects took part in this investigation. Thirty three subjects were college students who had registered for a circus arts course at the University of Wisconsin-La Crosse (UW-L). The remaining thirteen subjects were college students who had registered for a rock climbing course at UW-L.

Results

The means and standard deviations for each group are summarized in Table 1. The group means are also represented graphically in Figure 1.

Table 1. Means and Standard Deviations for Juggling Scores

Group	N	Statistic	Pretest	Posttest	Retention
Wall	24	Mean	4.8000	7.6167	8.4417
		SD	8.6628	9.1704	9.5269
Nonwall	22	Mean	6.7182	7.7909	10.1636
		SD	8.7811	9.7170	10.0195

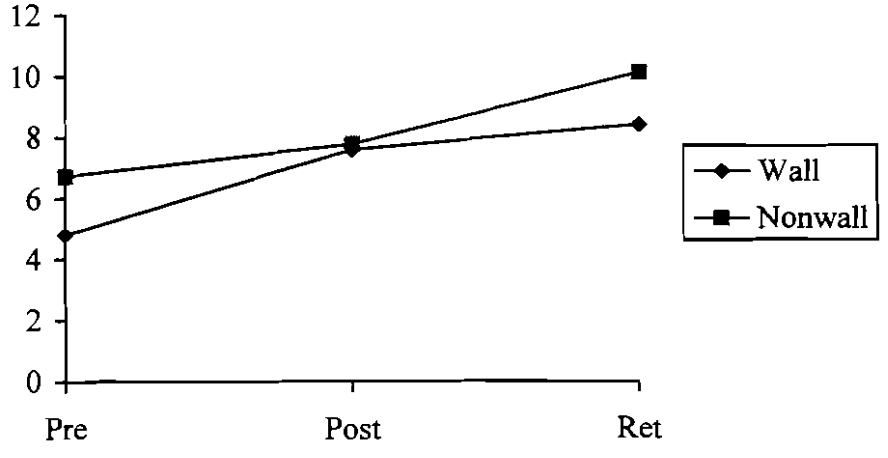

Figure 1. Group means in three test phases

The pretest results are summarized in Table 2 according to treatment group and gender. The pretest scores were of particular interest because they determined the statistical tools used for further comparisons.

Table 2. Means, Standard Deviations, and Range for Pretest Scores by Group and Gender

Group/Gender	N	Mean	SD	Range
Wall	24	4.8	8.6628	30
Nonwall	22	6.7182	8.7811	29.40
Males	24	8.9167	10.0681	29.40
Females	22	2.2273	5.0823	24.60

A two-way test of independent samples revealed no significant difference in the pretest means between treatment groups ($t = -.745$, $p = .460$). The wall and nonwall groups did not differ significantly in the pretest.

Investigation of gender differences in the juggling task was not a purpose of this study. However, a significant difference did exist across genders in the pretest.

A two-way ANOVA with repeated measures revealed a significant difference in performance from the posttest to the retention test for all subjects ($F = 7.936$, $p = .007$).

Taken as a whole, all subjects showed improvement from posttest to the retention test, but this improvement was irrespective of the treatment group to which the subjects were assigned.

A 2-way ANCOVA was used to test for significant differences between groups in the posttest, using the pretest means as the covariate. ANCOVA was selected because it adjusted for differences, albeit nonsignificant differences, in the pretest means. Thus, the comparison of posttest means assumed uniform performance in the pretest, and adjusted the posttest means accordingly when determining differences. This analysis revealed no significant difference between the treatment groups in the posttest ($F = 2.630$, $p = .112$).

Discussion

The first hypothesis of this study was that students who utilized wall practice in the early stages of learning to juggle would not significantly differ in juggling skill as compared to students who always practiced in an open space. Results indicated there was no significant difference between the wall and nonwall groups in juggling skill. The null hypothesis was supported.

The second hypothesis of this study was that there would be no significant improvement in juggling scores for subjects in either experimental group. Results indicated that while most subjects' juggling performance improved significantly during the study, this improvement took place regardless of the treatment group to which they were assigned. Following the treatment both groups showed uniform improvement in the post and retention tests. Therefore, the null hypothesis was not supported. Both groups

received identical instruction in juggling. The only difference between the two teaching methods was the location at which the subjects practiced juggling. The fact that the subjects as a whole improved their juggling skills irrespective of treatment group suggests that the instructional methods are effective for skill acquisition in college students, and/or that the subjects were allotted enough practice time for meaningful learning to take place. The teaching progression utilized in this study is described in Appendix C.

The results indicate that wall practice resulted in no better or worse performance than practice in an open space. This finding does not definitively determine whether or not wall practice is actually an aid to learning three-ball juggling, and there is some circumstantial evidence from the present study which would cast doubt on that speculation.

When given the opportunity to comment on the experimental procedures at the conclusion of the study, several subjects in the wall practice group remarked that they found the post and retention tests awkward because by that point they had become accustomed to juggling close to the wall. A number of students went so far as to ask if they could test at the wall rather than in the middle of the room in the retention phase. These comments suggest the possibility that a psychological dependence on the wall may occur in people who habitually engage in wall practice.

The possibility exists that wall practice is a superior training technique for accomplishing many consecutive throws in juggling, but that this effect would only be in evidence when the student juggles at the wall. If the subjects had been tested in their practice environment - the wall practice group at the wall and nonwall group in the open, the results might have shown the wall group had a greater proficiency. Due to the testing methods employed, a dependency effect could have caused this superiority, if present, to be masked in the post and retention tests. Although such a scenario does not appear likely to the present researcher, modification of the testing procedures may shed light on this possibility in future research. It also remains to be seen whether a dependency effect, if in fact present, could have a more long-term effect on performance of three-ball juggling. A longer retention interval than the 7 days utilized in the present study might be more effective in drawing out a dependency effect. Dependency on the wall could also have differential effects according to age. Younger students might not deal with such an effect as well as college students, and a comparison of the two age groups might yield insightful data.

Another possibility is that juggling skill acquisition is more heavily dependent upon the amount of time spent in practice than on teaching method. This supposition is supported by research which has found that student learning is heavily influenced by time-on-task. Future research may investigate this effect on juggling skill acquisition by varying the amount of practice time available to groups which utilize different pedagogical treatments. Although the investigation of gender differences in the juggling

task was not a purpose of this study, a significant difference did exist across genders in the pretest. This topic may also be of interest to future researchers.

Summary

Statistical analysis revealed that both the wall and nonwall groups significantly improved in their juggling skill from posttest to retention, but that the groups' improvement was equal. There was no significant difference between the two groups in improvement from posttest to retention. All other comparisons revealed no significant differences between the groups due to the two teaching methods.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary purpose of this study was to compare two techniques for teaching three-ball juggling. The secondary purpose was to determine if a significant learning effect took place for either experimental group. Forty six students at UW-L agreed to be subjects in the study. The subjects were divided into two groups: wall practice and nonwall. Each group participated in two 15-minute juggling lessons, and were tested on their juggling skills at three times: pretest (prior to the treatment), posttest (after the treatment), and retention (one week after the treatment).

A two-way test of independent samples was used to determine if the groups' pretest scores differed. This revealed no significant difference between the groups in the pretest ($p > .05$). A two-way ANOVA with repeated measures was used to determine if a difference existed in all subjects' scores from posttest to retention. It was determined that taken as a whole, the subjects improved in their scores significantly from post to retention ($p < .05$), but that this improvement was irrespective of treatment group. A two-way ANCOVA was used to determine if the groups' scores in the posttest were significantly different. It was determined that the groups did not differ significantly in their posttest scores ($p > .05$).

Conclusions

While the subjects significantly improved in their juggling skills during the study, this improvement was regardless of treatment group. The groups did not differ significantly in their improvement on the juggling task. Wall practice does not appear to be a hindrance or a help to three-ball juggling skill acquisition.

Some subjects in the wall practice group remarked that they felt dependent upon the wall during testing. Although, this effect was not revealed by statistical analysis, this possibility should be the focus of future research.

Recommendations for Future Study

Based upon the results and conclusions, the following recommendations for future investigations were made:

1. In order to determine whether wall practice actually assists in juggling skill acquisition, use three treatment groups - wall practice, nonwall, and a mixed treatment group which uses both methods in equal proportions. The resulting comparisons could be used to determine if wall practice is best used as a training tool on an occasional or consistent basis.
2. Modify the testing procedures to include tests both in an open space and at the wall. Use of this procedure could be used to determine if subjects perform better under their treatment specific conditions, and might also be more indicative of the subjects' true ability.

3. Investigate differences due to age by comparing college students to groups such as elementary school children. ANCOVA or MANCOVA could be employed to adjust for initial differences between the two groups.
4. Replicate the present study with varying time periods allotted for subject practice. This could be useful in determining the effects of time-on-task vs. teaching method.
5. Investigate differences across gender for various juggling tasks.

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APPENDIX A

INFORMED CONSENT

INFORMED CONSENT

TITLE: A COMPARISON OF TWO METHODS FOR TEACHING THREE-BALL JUGGLING

I, _____, give my informed consent to participate in this study of teaching techniques for juggling. I consent to presentation and publication or other dissemination of study results so long as the information is confidential and disguised such that identification of subjects is impossible. I further understand that although written and videotape records will be kept of my having participated in the experiment, the investigators agree to keep this information confidential.

1. I have been informed that my participation in this experiment will involve my learning how to juggle.

2. I have been informed that the general purpose of this experiment is to compare two teaching techniques for juggling.

3. I have been informed that there are no known expected discomforts or risks involved in my participation in this experiment. This judgment is based upon prior experience of the principal investigator, and upon other educational research of similar design.

4. I have been informed that there are no "disguised" procedures in this experiment. All procedures can be taken at face value.

5. I have been informed that the investigator will answer questions regarding the procedures of this study when the experimental session is completed.

6. I have been informed that I am free to withdraw from the experiment at any time without penalty, and also to remain enrolled in *ESS 100-341/342* after such action without penalty.

Questions concerning any aspects of this study may be referred to the principal researcher, Jason Catanzariti (796-2088), and thesis advisor, Dr. Jeff Steffen (785-6535).

_____ _____

Participant Date Investigator Date

APPENDIX B

DATA RECORDING SHEET

Data Recording Sheet

SUBJECT ID# : (circle) M F Date:

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
_____	_____	_____	_____	_____

APPENDIX C

LECTURE/DEMONSTRATION OF THREE-BALL JUGGLING

LECTURE/DEMONSTRATION OF THREE-BALL JUGGLING

Basic Three-Ball Juggling Instructions

The following instructions for learning three-ball juggling were given to each group of subjects. The instructor's verbal directions appear in quotations. Instances of modeling/demonstration are in parentheses. The same script was utilized in teaching both experimental groups.

"To juggle three balls, begin with two and try to make an X."

(Demonstrate)

"Wait until the first ball reaches the top, then throw the next one."

(Demonstrate)

"The balls cross in the air, making an X-shape."

(Demonstrate)

"It's not necessary to catch the balls. If you want, you can practice just throwing the balls up in the X, and then allow them to drop."

(Demonstrate).

"When you can do a good X and catch the balls, you are ready to try three. You must start with the hand which is holding two juggling balls. This can be either hand, but the hand which has two must go first. Throw the first ball up, throw the second ball up, and then throw the third ball up."

(Demonstrate)

"When you are practicing, throw all three balls even if they drop. Get them all out of your hands. Don't worry about catching them. If you don't throw them, you definitely won't catch them. *Throw all three balls even if they drop.*"

(Demonstrate)

"As you make better and better throws, you'll see that the catches become easier."

(Demonstrate)

"If you make three really good throws, the catches come naturally."

(Demonstrate)

"Watch me juggle the three balls for a moment."

(Demonstrate continuously while speaking)

"Notice that I am throwing the balls fairly high. This gives me more time for each throw. I'm also throwing just one ball at a time, and I'm watching the tops of my throws."

Group-Specific Practice Instructions

Wall Practice Group

The following instructions were given to the wall practice group immediately following the basic instructions for learning to juggle:

"There is one final instruction for when you practice. You will always do your juggling while standing on one of the tape lines which are near the wall."

(Demonstrate)

"By juggling close to the wall, you can tell if you are throwing too far forward. If the balls touch the wall, you should try to throw up closer to you. Pick a tape line, and always practice with your feet touching the line."

Nonwall Group

The following instructions were given to the nonwall group immediately following the basic instructions for learning to juggle:

"There is one final instruction for when you practice. You will always do your juggling while standing on one of the tape lines which are near the center of the room and away from the wall. Try to keep your feet on the line at all times while juggling." (Demonstrate)

"Pick a tape line, and always practice with your feet touching the line."