Mental Practice: Its Effects on Walking Balance in an Elderly Population

Cheryl A. Linden
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MENTAL PRACTICE: ITS EFFECTS ON WALKING BALANCE
IN AN ELDERLY POPULATION

by

Cheryl A. Linden

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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MENTAL PRACTICE: ITS EFFECT ON WALKING BALANCE IN AN ELDERLY POPULATION

Cheryl A. Linden, M.S.
Western Michigan University, 1987

The effect of mental practice on improving walking balance in an elderly population was studied. Walking balance was measured by the number of upper extremity equilibrium reactions elicited and placement of feet observed as subjects traversed an activity course. Twenty-three female subjects between the ages of 67-90 were randomly assigned to one of two groups. The experimental group mentally practiced traversing the activity course with the aid of a six minute audio tape. The control group participated in sedentary activities of equal duration. Both groups met for eight sessions. Independent and correlated t-tests indicated no significant difference in walking balance between groups at \( p < .05 \). There was a significant difference in equilibrium reactions when subjects carried objects as opposed to walking with their hands free at \( p < .05 \). The results and implications are discussed in terms of their significance to occupational therapy practice and research.
ACKNOWLEDGEMENTS

I would like to dedicate this thesis in loving remembrance to Coan Ulin; without her influence, this thesis would have never been attempted. Her perseverance and unique style made even the rough times a little easier to handle. I would like to thank my friend, Joan for her belief in the project and her willingness to take a chance. I could not have continued without her. To Kim: Your sense of humor, support and encouragement made the experience more bearable. Thank you.

I would like to express my appreciation to the following people whose contributions made this research possible: Doris Smith, M.Ed., OTR, FAOTA, my first reader, who provided guidance throughout the project; Mary Ann Bush, M.A., OTR, my second reader, who provided advice and expertise in the areas of mental practice and equilibrium reactions; Molly Vass, Ed.D., my third reader, who provided support and offered constructive advice regarding the content of the thesis; the activity directors at Merrill Residence, Evergreen North and Directors Hall for their time and energy in helping to recruit residents to participate; the residents, for their willingness to participate; and Tim Hall, OTS and Kelly Parps, OTS for their help on this thesis.

Cheryl A. Linden
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INTRODUCTION

"Falls are the single greatest cause of accidental deaths in elderly, accounting for over half of all accidental deaths in this age group" (U.S. Department of Health, Education and Welfare, 1970, p. 27). A large percentage of these falls involve fractures, which lead to immobilization (Uden, 1985). This immobilization results in a decrease in functional living skills, which may necessitate premature placement in institutions. Institutionalization is a concern of occupational therapists, because one major focus of intervention is to maintain independent living skills and productivity. Because "balance is critical to effective and efficient movement and posture" (Roberts & Fitzpatrick, 1983, p. 151), the purpose of this study was to determine means by which to improve balance in elderly women. Poor balance increases the risk of falls, which may then lead to immobilization, thereby necessitating early institutionalization. The technique of mental practice to improve balance was chosen because it has been shown to be effective in improving different types of motor skill performance in a wide range of ages (Corbin, 1967; Fansler, Poff, & Shepard, 1985; Korn & Johnson, 1983; Richardson, 1967).

Mental practice is defined as "the symbolic rehearsal of a physical activity in the absence of any gross muscular movements" (Richardson, 1967, p. 95). Mental practice has been the term most frequently used, though the terms visual imagery, mental rehearsal,
imaging, visualization, and ideokinetic facilitation appear in the literature (Fansler et al., 1985). For the purpose of this study the term mental practice was used to describe the process of picturing in one's mind the perfect performance of a motor skill and its kinesthetic feel (Fansler et al., 1985). There is documented evidence that during mental practice there is actual muscle spindle excitation, resulting in minuscule muscle contractions. In Jacobson's study (1932) when subjects were asked to mentally practice lifting a ten pound weight, electrical fluctuations in muscle fibers were found to be occurring. These fluctuations were not present during the times the subjects were not performing mental practice. Shick (1969) noted varying degrees of muscular involvement from an electromyogram during the mental practice of volleyball skills. These muscular contractions provide the proprioceptive feedback that one would normally get from physical practice (Jones, 1965). Mental practice has a direct effect on the central nervous system, acting as feedback in much the same way as physical practice (Fansler et al., 1985; Jones, 1965).

Educators have accepted the premise that learning can occur by observing a model and does not require actual physical practice. In a study by Jones (1965), subjects were exposed to a person performing a gymnastic maneuver once. After observing this maneuver the subjects were divided into two groups. The subjects in one group were mentally guided through the maneuver each step of the way; subjects in the other group were allowed to mentally practice the maneuver without guidance. Those allowed to perform the maneuver without guidance performed better than those whose mental practice was guided through
each component of the skill. Jones reported the non-guided mental practice technique allowed subjects to form a kinesthetic image of the practice skill in its entirety rather than in its component parts and was, therefore, more effective. As stated in the principles of neurodevelopmental treatment, it is not the actual movement of the muscle that is learned, but rather, the sensation of that muscular movement that is learned (Bobath & Bobath, 1974). "If this is true, then the mental sensation of image of movement is as important to the learning or relearning of the movement as physical practice" (VandeSteeg, 1986, p. 3).

Mental practice has been shown to be effective in improving motor performance. Vandell, Davis and Clugston (1943) studied the effects of mental practice on the acquisition of motor skills, using basketball free throw shooting and dart throwing with high school boys. They concluded mental practice appeared as effective as physical practice. In another study, Clark (1960), using a one hand basketball free throw shot with high school boys, reported that mental practice was effective in improving this motor skill. His findings also indicated that the more familiar the subject was with the task the more beneficial mental practice was in improving that motor task. Corbin (1967) studied the effects of mental practice on improving juggling skills of college men over a period of 21 days; he determined that a combination of physical practice and mental practice was most effective in improving these skills. In a ring toss experiment lasting 22 days, Twining (1949) reported that mental practice was "a means of facilitating the learning of motor skills" (p. 434). Mental
practice periods ranged from 1 minute to 30 minutes in these cited studies. In reviewing the literature, there was no indication that any one time frame for mental practice was more effective than any other time frame. Twining (1949) reported that concentration during mental practice was sustained for 5 minutes, but became increasingly difficult to maintain beyond that time. In his experiment, subjects were required to individually mentally practice the ring toss immediately prior to performing the ring toss. In a study by Smith and Harrison (1962), college men were asked to mentally practice a 3 hole punch task, immediately preceding the actual performance of the task. Mental practice was found to be effective in improving eye-hand coordination in a series of 6, 10 second practice periods over one day. In a study done by Fansler et al. (1985) subjects listened to a dialogue consisting of 5 minutes and 15 seconds of relaxation, followed by 3 minutes and 50 seconds of suggestions for images related to a one-legged balance task they were to perform. This study was a pretest-posttest design covering a period of 5 days in which subjects listened to the dialogue for 3 consecutive days. Fansler et al. reported mental practice coupled with physical practice was effective in improving one-legged balance in elderly women.

It appears the more often an individual performs mental practice, the easier it is to produce a mental image (Ungerleider, 1985). In order to enhance this process further, relaxation techniques are used prior to the actual mental practice. Bakan (1980) stated "it is evident to people who work with imagery that relaxation is conducive to the experience of imagery" (p. 40). Imagery is enhanced when the
person doing the imaging is relaxed (Klinger, 1980). Once a person achieves a state of relaxation, the manner in which mental practice is carried out also affects the performance of the skill. In a study with elite skiers, those skiers who could visualize and experience the kinesthetic feel of performing the task in their sessions of mental practice were most successful skiing. Their visualizations included seeing the tips of their skis and the course before them as if they were actually skiing the hill. The skiers whose mental practice involved watching themselves ski as if on a television screen were less successful skiing (Rotella, Gansneder, Ojala, & Billing, 1980).

Most studies have used mental practice with young adults in areas of higher motor skills; however, few studies were found using mental practice with a fundamental motor task, such as walking balance in an elderly population. Studies report that in the elderly, changes in gait and a higher center of gravity result in poor balance, leading to falls (Finley, Cody, & Finizie, 1969; Hasselkus, 1974). As one ages, there is a degeneration of muscle fiber which results in a weakening of the trunk muscles (Gutmann, Hanzlikova, & Jakoubek, 1968; Serratrice, Roux, & Aquaron, 1968). This weakening of the trunk muscles affects the efficiency of the proprioceptive feedback mechanism (Hasselkus, 1974) and combined with increased reaction time (Atchley, 1987), diminishes the effectiveness of balance and equilibrium reactions. In order to compensate for this problem elderly persons have a shorter step length and a wider gait than younger persons. This gait creates a side to side sway, as the elderly tend to shift their body weight from the ball of one foot to
the ball of the other (Tokumasu & Kawano, 1976), known as postural sway. Postural sway is defined as the subtle shifting of a person's center of gravity while standing and/or walking (Hellebrand, 1938). This sway is observable as a person maintains balance, though it increases with age, is greater for females than males (Overstall, Exton-Smith, Imms, & Johnson, 1977), and increases the tendency to fall in the elderly (Chipman, 1981).

While some postural sway is present when a person is in a state of balance, as the body's center of gravity becomes more displaced, equilibrium reactions are elicited in an effort to maintain the body's center of gravity over the base of support (Bobath, 1985). Further displacement of the body's center of gravity elicits a protective extension reaction, which is an extension of the arms and hands to protect the head from injury when one is at the point of falling (Bobath, 1985).

The elderly tend to bend forward at the trunk to prevent loss of balance, which places them in a poor position from which to right themselves. This forward flexion of the trunk, combined with the decrease in strength of the postural muscles of the trunk result in inadequate balance and equilibrium reactions (Serratrice et al., 1968). A young person relies on a protective extension reaction to recover balance, but an elderly person often relies on a cane or assistive device to aid balance (Hasselkus, 1974). Having to rely on these assistive devices or other supports impinges upon the ability of the elderly to move around in their environment.
Many falls are caused by environmental hazards (Rubenstein & Robbins, 1984; Sheldon, 1960), such as missing a step, tripping over edges of rugs and carpets (Hasselkus, 1974) or falling while getting out of the bathtub (Uden, 1985). Limitations in the mobility of elderly persons may be detrimental to everyday functional activities, such as bathing, dressing, shopping and homemaking (Hogue, 1984). These activities of daily living are imperative to independence in the lives of the elderly. Not only do the assistive devices impede functional performance, but they place the elderly at a greater risk for falls and possible fractures (Wild, Nayak, & Isaccs, 1981). Rubenstein and Robbins (1984) reported other aspects contributing to falls include decreased vision, impaired hearing and poor memory. These, in combination with environmental hazards of the home (stairs, poor lighting, rugs), increase the likelihood of falling. The frequency of these accidents tends to be greatest in persons between the ages of 70-74, with women being more likely to fall than men (Perry, 1982).

According to Sheldon (1960), the control of posture is a learned response. If this is so, then the technique of mental practice, used with the elderly, may be an effective technique in minimizing changes in balance due to the aging process, thereby reducing the risks of falls. This interaction of the mind and body has been historically acknowledged by occupational therapists and is basic to their scope of practice. Dr. Robert Bing (1981) stated that the mind and body are "inextricably conjoined" (p. 515). Occupational therapists treat the individual as a unified whole and not as a sum of its discrete parts.
(Yerxa, 1983). "Scientific evidence has demonstrated that much of what we previously thought of as uncontrollable is controllable if we learn the proper method of exercising this control" (Korn & Johnson, 1983, p. vii). The use of mental practice, being one's own resource, changes the locus of control from external to internal (Taylor, 1985). This is a basic concept in occupational therapy's scope of practice.

The present study sought to improve walking balance in elderly women over a two week period, using mental practice techniques. The study measured balance by the number of incidents of equilibrium reactions observed, while subjects traversed an activity course. Another indicator of balance was a person's ability to maintain foot placement on a simulated balance beam.

Hypotheses

The present study was designed to answer two questions. Does mental practice improve walking balance in elderly women? Is there a significant difference between the number of sessions of mental practice and improvement seen in walking balance? The 4 null hypotheses tested were: (1) Given four sessions of mental practice, elderly women in the experimental group would not significantly improve their walking balance (based on 2 measures) when compared to the group receiving no mental practice; (2) Given 4 sessions of mental practice, elderly women in the experimental group would not demonstrate a significant improvement in their walking balance; (3) Given 8 sessions of mental practice, elderly women in the experimental group would not improve their walking balance significantly more than
when given only 4 sessions of mental practice; and (4) Given 8 sessions of mental practice elderly women in the experimental group would not increase their walking speed significantly more than the control group.
METHODS

Subjects

Twenty-two elderly female subjects who were independent and in good health, between the ages of 67-90 were recruited from three local senior citizen apartment complexes. They were asked to voluntarily participate in one of the following groups: (a) eight days of mental practice training; and (b) eight days of sedentary activities. Prior to the subject's participation, appropriate consent was obtained (see Appendix A). As part of the consent procedure, subjects were informed of the research activity requirements. Based upon these requirements each subject was self-screened for adequate vision, hearing and independence in mobility without the use of prostheses or assistive walking devices. In addition, subjects were screened to determine general status of balance (see Appendix B).

Apparatus

The activity course, designed to measure balance, consisted of a 32 foot by 18 inch carpeted walkway (see Figure 1). The first 18 feet of the carpeted walkway contained a 4 inch wide strip of masking tape placed in the center of the walkway, simulating a balance beam. The simulated balance beam was followed by an 8 foot long, 6 inch high ramp with a 4 degree slope. To the right of the step end of the ramp was a 3 foot square card table set with a glass of juice and a plate
Figure 1. Course Diagram
with cookies. One of the researchers and one volunteer were "spotters" on either side of the step end of the ramp, to ensure subject safety. This course was used for all measures of the dependent variable. Each subject was videotaped as she performed the pretest and the 2 posttests. A RCA camcorder was used to record the 2 components of balance being measured. During this videotaping, the camera was positioned 12 feet beyond the step end of the ramp and in line with the simulated balance beam. The angle of the camera enabled the researchers to view each subject traversing the entire course. The stationary camera was operated by one of the researchers. Each subject's traversing time was recorded in seconds, using the timing device on a VCR.

A 6 minute tape of mental practice techniques was recorded on a portable cassette stereo player/recorder. See Appendix C for a script of this recording. The same player/recorder was used to play back the mental practice techniques to the experimental group. The 2 researchers served as group leaders and introduced the tape to the subjects.

Instrumentation

The two researchers viewed the recorded video tapes and documented the occurrence of equilibrium reactions in three areas: the simulated balance beam, the ramp, and the step end of the ramp. Each incident of an equilibrium reaction was recorded on the Subject Data Sheet (see Appendix D) when any of the following was observed: (a) flexion and/or abduction of the arms at the shoulders; extension
or abduction of the hips, or a combination of both; (b) lateral flexion of head and trunk; (c) hopping reaction of lower extremities (Izraelevitz, Fisher, & Bundy, 1985); and (d) using "spotters" for support.

Subjects stood on two rubber footprints at the beginning of the balance beam. These markers acted as a reference point from which to begin measuring equilibrium reactions. Equilibrium reactions were recorded during all steps taken on the ramp. A single step on and off the ramp was recorded separately. The total incidents of equilibrium reactions were recorded on each Subject Data Sheet. This same procedure was followed as subjects traversed the course in both directions.

For the second measure of balance, the researchers recorded the number of times subjects stepped off the balance beam, beginning with step one until the end of the balance beam. For each step taken on the balance beam a score of one or two was assigned (on each Subject Data Sheet). A one was given when the entire foot remained on the four inch wide balance beam; a two was given when any portion of the foot was off the beam (the entire foot, the ball or heel of the foot, the right or left side of the foot). The total number of steps on the balance beam and the total number of steps off the balance beam were recorded. This same procedure was followed as subjects traversed the course in both directions.

The total time of the pretest and both posttests of each subject traversing the course was recorded on each Subject Data Sheet. Total traversing time of the experimental and control groups was compared.
This enabled the researchers to determine the effects of mental practice on walking speed.

Interobserver agreement of measures of balance was established at 80% agreement during a pilot study using four subjects conducted prior to the research study.

Procedure

The subjects were randomly assigned to one of two groups in each of the apartment complexes. Eleven subjects were assigned to the experimental group and twelve subjects were assigned to the control group.

To establish a baseline of walking balance, subjects were pretested. The pretest was videotaped. Subjects were positioned on stationary markers (two rubber footprints) at the beginning of the simulated balance beam. Each subject walked the simulated balance beam, up the ramp, stepped off the end of the ramp and walked to the end of the table. Each subject then picked up the glass of juice and the plate with the cookies, turned around and walked back to the ramp. She stepped up onto the ramp, walked down the ramp and the simulated balance beam, to the starting position. The researchers set up another glass of juice and another plate with cookies for the next subject. This procedure was repeated until all subjects completed the activity.

On day one all subjects were pretested and videotaped. Following the pretest, subjects in the experimental group met for days 2 through 5 and 7 through 10 for 6 minutes of mental practice. Following the
pretest, the control group met for days 2 through 5 and 7 through 10 for 6 minutes of sedentary activities. On the 6th and 11th days both groups were posttested traversing the activity course. These posttests were videotaped. The pretest and both posttests were recorded on 3 separate video tapes.

Subjects in the experimental group listened to the 6 minute tape, which assisted them in using mental practice techniques to visualize themselves traversing the activity course. The sedentary activities the control group participated in consisted of remembering contents in a jar, 20 questions, and 2 word games.

It was important for the control group to meet daily in order to maintain equality between the two groups in terms of time spent together (i.e., motivational factors). To prevent leader bias and effect, the two researchers alternated daily between meeting with the experimental group and meeting with the control group for the duration of the study. The above procedure occurred in each of three apartment complexes, Monday through Friday at the same time, during the same two week period.

To begin the experimental group sessions (mental practice activity), the researcher said "Thank you for coming today. After everyone is seated in a comfortable position we will start. I will be glad to answer any questions you may have when the tape is finished." To begin the sessions with the control group (sedentary activities), the researcher said "Thank you for coming today. After everyone is seated in a comfortable position we will begin the activity." At the end of each session (experimental and control), the researchers said
"Thank you for participating. We will see you tomorrow. Please do not discuss these activities with anyone." The experimental group was asked not to mentally practice walking the course until the next session.

Upon completion of the study, a volunteer coded the three video tapes and the two researchers were blind to the code. The researchers were then randomly assigned a coded tape to avoid identification of the order of performance. Each researcher independently reviewed half of the video tapes of the pretest and posttests to measure and record walking balance and the time to complete the course.

Data Analysis

Independent and correlated T-tests from the Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) were used to test the four null hypotheses proposed for this study. To test the first three hypotheses, all equilibrium reactions, which included the foot placements off the beam plus the upper extremity reactions for coming and going, were totaled and used in the comparisons. To test the fourth hypothesis, a correlated t-test from SPSS (Nie et al., 1975) was used to compare the total time traversing the course, excluding the time spent picking up the refreshments.
RESULTS

No significant differences were found between the mental practice group and the control group in terms of balance status, age, or walking balance, based on the two measures of balance (equilibrium reactions and foot placement) at the time of the pretest. The comparison of the experimental group to the control group on the pretest for equilibrium reactions indicated they were not significantly different, with $t(21) = .76, p = .45$. A comparison between groups for foot placement on the pretest was also not significant, with $t(21) = 1.13, p = .27$.

The first null hypothesis that four sessions of mental practice would not improve walking balance significantly more than the control group activity could not be rejected. The independent $t$-test was $t(21) = .08, p = .42$ (See Table 1).

Correlated $t$-tests were used to analyze data to test the second and third hypotheses. The second null hypothesis that elderly women would not significantly improve their walking balance after four sessions of mental practice could not be rejected since $t(10) = .85, p = .42$ (See Table 2). The third null hypothesis that there would be no significant improvement in walking balance after eight days of mental practice did not reach significance; $t(10) = .49, p = .63$ (See Table 3).
### Table 1
Comparison of Walking Balance After Four Days

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>df</th>
<th>$t^a$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>11</td>
<td>15.0</td>
<td>8.7</td>
<td>21</td>
<td>.80</td>
<td>.44</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>12.5</td>
<td>5.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Condition equals total equilibrium reactions plus foot placements off the beam.

$^a$ = independent $t$-test from SPSS (Nie et al., 1975) used for comparing the two groups on the total number of equilibrium reactions in the upper and lower extremities, while traversing the course added to the total number of foot placements off the beam.

### Table 2
Effect of Four Sessions of Mental Practice on Walking Balance in Experimental Group

<table>
<thead>
<tr>
<th>Condition</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>N</th>
<th>df</th>
<th>$t^a$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>17.3</td>
<td>8.1</td>
<td>11</td>
<td>10</td>
<td>.85</td>
<td>.42</td>
</tr>
<tr>
<td>Posttest 1</td>
<td>15.0</td>
<td>8.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Condition equals total equilibrium reactions plus foot placements off the beam.

$^a$ = correlated $t$-test from SPSS (Nie et al., 1975) used for comparing before and after four days of mental practice.
Table 3

Effect of Mental Practice on Walking Balance in the Experimental Group After Eight Days Compared to Four Days

<table>
<thead>
<tr>
<th>Condition</th>
<th>( \bar{X} )</th>
<th>SD</th>
<th>N</th>
<th>df</th>
<th>( t^a )</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest 1</td>
<td>15.0</td>
<td>8.7</td>
<td>11</td>
<td>10</td>
<td>.49</td>
<td>.63</td>
</tr>
<tr>
<td>Posttest 2</td>
<td>13.6</td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Condition equals total equilibrium reactions plus foot placement off the beam.

\( a = \) correlated \( t \)-test from SPSS (Nie et al., 1975) used for comparing the effects on total equilibrium reactions after four days versus eight days of mental practice.

The fourth null hypothesis that after eight sessions of mental practice elderly women will not increase their walking speed significantly more than the control group could not be rejected. An independent \( t \)-test was \( t(21) = -.20, p = .85 \) (See Table 4).
<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>df</th>
<th>t_a</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>11</td>
<td>25.5</td>
<td>11.0</td>
<td>21</td>
<td>-.20</td>
<td>.85</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>26.7</td>
<td>15.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** a = independent t-test from SPSS (Nie et al., 1975) used for comparing two groups on time traversing the course, excluding time spent picking up refreshments.

None of the hypotheses proposed for this study could be rejected.
DISCUSSION

Several factors may account for the nonsignificant results of the hypotheses proposed for this study. A high rate of absenteeism in the experimental group, perhaps due to the independent living arrangements of the subjects and their conflicting commitments, may have contributed to the lack of significant effects of directed mental practice.

The tape used for guiding the mental practice may have been another factor. The subjects from the experimental group reported that their personal visualizations were consistently ahead of the mental practice tape. This suggests the tape dialogue moved them through the course too slowly and may have reduced the effectiveness of the practice sessions. Another possible limitation in the study was the use of guided mental practice to direct the subjects through the course. According to Jones (1965), non-guided mental practice proved to be superior to guided mental practice in performing a gymnastic maneuver. In future studies, a non-guided mental practice approach is recommended. Subjects should listen to a tape composed of both relaxation techniques and suggestions for maintaining balance followed by a silent period when they are asked to mentally practice walking through the course.

Only one of the 23 subjects had any prior knowledge of mental practice. This lack of familiarization, plus the comments made by
several subjects to researchers which indicated they were suspicious of "mind control," may have decreased the effectiveness of mental practice. Future studies should focus on using mental practice with different populations in order to observe effectiveness.

This research was designed for persons aged 65-80 in order to minimize intersubject variability. The age of the subjects within this study ranged from 67-90, a span of 23 years. Due to the prior commitments of many potential subjects, meeting for 2 weeks every day at a specified time was not possible. Therefore, all volunteers who met the criteria, were accepted, regardless of their ages.

Another limitation may have been that 8 days of mental practice was too long to sustain subject interest, motivation and attendance. Attendance for the experimental group was significantly lower (76% of possible sessions) than the attendance of the control group (93% of possible sessions). A chi square analysis of attendance resulted in a $\chi^2 (1) = 9.77, \ p < .01$ (See Table 5).
Table 5
Chi-Square Analysis of Attendance in Experimental and Control Groups

<table>
<thead>
<tr>
<th>Condition</th>
<th>Did Attend</th>
<th>Did Not Attend</th>
<th>Total Possible Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>67.0</td>
<td>21.0</td>
<td>88</td>
</tr>
<tr>
<td>(N = 11)</td>
<td>(74.6)a</td>
<td>(13.4)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>89.0</td>
<td>7.0</td>
<td>96</td>
</tr>
<tr>
<td>(N = 12)</td>
<td>(81.4)</td>
<td>(14.6)</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>156.0</td>
<td>28.0</td>
<td>184</td>
</tr>
</tbody>
</table>

Note. $\chi^2 = 9.77$, $p < .01$

$^a$ = Expected frequencies shown in parentheses below observed frequencies.

The subjects in the control group reported that they enjoyed the variety of word games and looked forward to coming everyday. Those in the experimental group made no positive comments, but did comment on the slowness of the tape and mind control.

Review of the data also showed that there were significant differences in upper extremity equilibrium reactions when subjects carried objects as opposed to walking with their hands empty. The number of equilibrium reactions observed on the beam and ramp...
decreased significantly as subjects returned carrying the cookies and the juice. A t-test of each of the three measures (pretest, posttest 1, and posttest 2) showed that there were significantly fewer equilibrium reactions when the subjects carried the cookies and the juice (specified as "going") than compared to not carrying the refreshments (specified as "coming") (see Table 6). The decreased equilibrium reactions may have resulted from an increase in proximal tone due to the subjects' grasp and fixed position of their arms and forearms.
**Table 6**

Comparisons of Coming vs. Going: Measures of Equilibrium Reactions and of Foot Placement (N = 23, df = 22)

<table>
<thead>
<tr>
<th>Test</th>
<th>Condition</th>
<th>( \bar{X} )</th>
<th>SD</th>
<th>( t^a )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equilibrium Pretest</strong></td>
<td>Coming</td>
<td>4.7</td>
<td>5.3</td>
<td>2.26</td>
<td>.034</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>3.0</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equilibrium Posttest 1</strong></td>
<td>Coming</td>
<td>3.5</td>
<td>4.1</td>
<td>2.75</td>
<td>.012</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>1.5</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equilibrium Posttest 2</strong></td>
<td>Coming</td>
<td>4.6</td>
<td>4.6</td>
<td>3.25</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>1.9</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Foot Placement Pretest</strong></td>
<td>Coming</td>
<td>.38d</td>
<td>.15</td>
<td>-4.00</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>.49</td>
<td>.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Foot Placement Posttest 1</strong></td>
<td>Coming</td>
<td>.34</td>
<td>.20</td>
<td>-.46</td>
<td>.648</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>.36</td>
<td>.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Foot Placement Posttest 2</strong></td>
<td>Coming</td>
<td>.36</td>
<td>.20</td>
<td>-2.43</td>
<td>.024</td>
</tr>
<tr>
<td></td>
<td>Going</td>
<td>.43</td>
<td>.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.**  
\( a = \) correlated \( t \)-test from SPSS (Nie et al., 1975) used for comparison of measures of equilibrium reactions and foot placement.

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placement in two directions (coming and going).

b = "coming," referring to walking toward the camera and not carrying the cookies and juice.

c = "going," referring to returning from the table carrying the cookies and juice with subject's back to the camera.

d = the mean and standard deviation representing percentage of foot placements off the beam based on total steps taken.

In contrast to the above finding, foot placement off the beam increased significantly in two of the three measurements (see Table 6) as subjects returned carrying the cookies and the juice. This increase may have been a result of subjects not having their arms free to assist them in regaining their balance. The increase in foot placement off the beam may have been a compensation for not using the upper extremities and torso for equilibrium reactions. Another observation was that the subjects' attention was focused on the objects they were carrying rather than on their foot placement. An explanation for more foot placements off the beam may have been the lack of rubber footprints to center subjects on the beginning of the balance beam after picking up the juice and cookies. The lack of markers may have caused the subjects to initially align themselves off center, making it difficult to regain centered foot placement on the beam while returning. In future studies, use of markers at each end of the beam will isolate whether or not the subjects are starting off center or whether carrying objects, results in an increase in equilibrium reactions in the lower extremities, with a consequent decrease in equilibrium reactions in the upper body.
CONCLUSION

This research investigated the impact of mental practice on improving balance skills in elderly women. The experimental group participated in eight days of mental practice and the control group participated in eight days of sedentary activities. The four hypotheses proposed in this study could not be rejected at the .05 level. A small sample size, the wide age range of subjects, inconsistent participation by the experimental group, and/or the slowness of the mental practice tape may have contributed to these results.

A post hoc analysis of data showed that there were significant differences in upper extremity equilibrium reactions and in foot placement dependent on whether the subject walked carrying an object in each hand or walked with empty hands.

Further research needs to be done in the area of mental practice, incorporating different ways of administering the mental practice techniques and using different populations. Future research may help to determine if mental practice can be used effectively in conjunction with traditional treatment methods in rehabilitation and activities of daily living training, and within home programs.
APPENDICES
Appendix A

Informed Consent Form
INFORMED CONSENT FORM

We are graduate students in occupational therapy at Western Michigan University. We are required to do a research project as part of our graduate work. We are interested in finding out more about women over 65 who reside in senior citizen's apartments. You will be helping occupational therapist's learn more about how women over 65 respond to activities.

If you should agree to participate in this study, you may learn some relaxation techniques and be asked to do the following on three occasions over a period of two weeks: 1) walk a designated walkway, containing a ramp with two people on either side, to a table with refreshments; 2) obtain the refreshments and return by way of the walkway. You will be videotaped during the above procedure. You may also be asked to participate in some activities that require talking and listening. The above tasks will require ten minutes of your time each day for 10 days.

The information collected will be coded so that no one will be able to identify you in any way. The information gained will be used for this research project only and/or for publication in a professional journal. The videotape will be used for data collection only; it will not be made public.

You are free to stop participating in this study at any time. Withdrawal from this study will cause no loss of benefits to you and will not affect your status as a resident of this apartment complex.

Any questions will be answered promptly. You may leave a message for us at the occupational therapy department at 383-1765. You may reach our advisor for this study, Doris Smith, M.Ed., OTR, at the same number.

Thank you.

Sincerely

______________________ OTS
Joan E. Uhley,

______________________ OTS
Cheryl A. Linden

(appendix continues)
(Appendix A continued)

Consent:
I have read and understand all of the information on the consent form. All of my questions have been answered and I agree to participate in this study.

______________________________  ________________________
Participant's Signature        Date
Appendix B

Balance Survey
Name: ______________________
Age: ______
Birth date: ________________

1) When you stand up quickly do you experience spells of dizziness?
    yes  no

2) If yes does this occur often?
    yes  no

3) Have you had any falls in the past year?
    one  more than one  none

4) If yes, did any of these falls result in a break or fracture of bones?
    yes  no

5) Have you ever had self-hypnosis, biofeedback training, mental practice training or related technique?
    yes  no
Appendix C

Tape Dialogue
TAPE DIALOGUE

Close your eyes...Just let your body go...allow it to be totally supported by the chair...Without any effort on your part...just let all the muscles throughout your entire body relax...let them go limp...Now breath in very deeply and let the air go out slowly from your lungs...Feel your chest move in and out...as you breathe...Imagine your breath as a wave...It rolls in as you breath in...It gathers up the tension in your body...As you breathe out...the wave rolls out, carrying all of your tension with it...The wave rolls in...The wave rolls out...as it spreads throughout your body...you are becoming more relaxed...Breath deep and feel yourself relax...You are feeling strong and secure like an oak tree...Remember what it was like to play balancing games as a child...Remember how long you could balance playing hopscotch...Remember how easy and fun it was to walk along a thin wall...Think about your balance now...Realize that the balance you had as a child is still yours...You can balance.../...Now continue to use your imagination...Remember the room where we had you walk through the activity course...Now imagine this course in front of you...And try to imagine now, walking through this course...You are relaxed and strong and secure...See the taped line on the carpet and place yourself in front of it...Try to picture the color of the carpet...picture the ramp at the end of the line...Notice the refreshment table slightly to the right of the ramp...Notice the glass of juice and the plate with the cookies on the table...Now go ahead and start walking through the course as you did before...Stand on the line and now imagine yourself walking down the track...Your walk is steady and your feet are on the line...Your feet are planted firmly on the line...Your back is straight...Feel the carpet under your feet...You have no problem keeping your balance and you are steady...Picture yourself now approaching the ramp...Feel yourself going up...And then stepping off the ramp...As you step off the ramp, you see the refreshments on the table to the right...You walk effortlessly to the table...You reach for the glass...And then reach for the plate with the cookies...You then turn around and walk back to the ramp...You are holding the plate with the cookies and the glass of juice...Now you step up the ramp...You walk down, keeping your balance...As you walk down the ramp then step on to the line once again...You begin walking down the line...Again with your head held up...Your back is erect and your are walking straight and strong and secure...keeping yourself stable as you go along...You walk towards the end of the line and finish the course.../...Now that you have finished, just relax...You have finished the entire course, with no problem at all...Now allow yourself to feel good about what you have just done...Give yourself permission to feel good about what you have
accomplished just by using the power of your own imagination...You were able to do this task without any problem at all.../...And now, slowly prepare to open your eyes...to make contact once again.
Appendix D

Subject Data Sheet
### Subject Data Sheet

**Subject Code:** _______________  **Tape:** A B C

#### Incidents of Equilibrium Reactions (ER) on Beam:

<table>
<thead>
<tr>
<th>C</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Incidents of ER on Ramp:

<table>
<thead>
<tr>
<th>C</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Incidents of ER on Step:

<table>
<thead>
<tr>
<th>C</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Foot Placement on Beam:

<table>
<thead>
<tr>
<th>C</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Traversing Time:

<table>
<thead>
<tr>
<th>Pretest</th>
<th>Posttest 1</th>
<th>Posttest 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 - on the beam  
2 - off the beam  
✓ - indicates incidents of equilibrium observed  
C - subject walking towards camera  
G - subject walking away from camera

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BIBLIOGRAPHY


Tokumasu, K., & Kawano, R. (1976). Head sway during stepping in old and young adults. *Agressologie*, 17(B), 1-6.


