AN ABSTRACT OF THE THESIS OF

ALICE MARIE BOARMAN for the degree of DOCTOR OF EDUCATION in Education presented on July 7, 1977.

Title: EFFECT OF FOLK DANCING UPON REACTION TIME AND MOVEMENT TIME OF SENIOR CITIZENS

Abstract Approved: Redacted for Privacy
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With the neuromuscular performance deficit typically associated with aging, the maximum rate of response of the individual is diminished with advancing age. Physical activity has recently been examined as a possible factor delaying the aging process as it relates to neuromuscular performance. This investigation examined folk dancing as a potential modality for altering the speed of reaction and speed of movement of senior citizens. Forty subjects aged sixty to ninety-four were measured for reaction time and movement time using a simple movement of the right foot. Subjects were signaled to respond with a red light stimulus. Following the pre-test the experimental group, including eighteen females and two males, participated in a folk dance program. The dance program included instructional classes meeting twice a week for five weeks. The control group, which included eighteen females and two males, did not participate in dance classes. All subjects were remeasured after the five-week experimental

period. Analysis of variance suggested that: a) five weeks of folk dance participation did not significantly influence simple reaction time of older individuals and b) five weeks of folk dance participation did not significantly influence movement time of older individuals.

The Effect of Folk Dancing Upon Reaction Time and Movement Time of Senior Citizens

by

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A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Education

Completed July 1977

Commencement June 1978

APPROVED:

Redacted for Privacy

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Date thesis is presented July 7, 1977

Typed by Clara Homyer for Alice Marie Boarman

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CHAPTER I

INTRODUCTION

With advancing age, changes occur in the performance of complex skills that imply changes in the properties of the nervous system. The neuromuscular performance decrement typically associated with aging suggests that the range of response to environmental stimulation is diminished in the older individual. As a possible indicator of nervous system integrity, speed of response has received attention in the literature on aging.

Speed of response can be divided into two separate entities for examination: reaction time and movement time. Reaction time is the timing of behavior from the moment a stimulus is presented until the moment a response is initiated. Movement time is the time period from the initial response to the completion of the movement or response. Reaction time and movement time tend to increase with advancing chronological age.

Attempts have been made to isolate factors responsible for age changes in the ability to react and to move quickly. Nature of habitual daily physical activity has been identified as a factor which may influence the speed of

response of the older person. Some results indicated that more physically active older individuals tend to respond and to move more quickly than older people who are sedentary. However, research efforts studying activity programs aimed at altering the response characteristics of older people are minimal.

Significance of the Study

The relationship between age and speed of response has been traditionally accepted for many years. Only recently has physical activity been suggested as a possible factor modifying speed of response with age. Therefore, this study of the effects of a program of moderate physical activity upon reaction time and movement time of older individuals seemed warranted. Since dancing is a social activity found both acceptable and enjoyable by individuals of all ages, folk dancing was selected as the experimental condition.

Methodology

The subjects were male and female volunteers sixty years of age or over, residing in Corvallis, Oregon. Initially, the subjects were assigned to an experimental group or to a control group and were measured for simple reaction time and movement time of the right foot. The experimental factor was a five-week program of folk dance.

Both groups were remeasured after the experimental group had undertaken a five-week program of folk dancing. Groups by trials analysis of variance was used to determine the effects of folk dancing upon reaction time and movement time.

Dance Program

The dance program consisted of an instructional class in folk dancing. The experimental subjects attended two 60-minute dance classes each week for five weeks.

Statement of the Problem

The purpose of this investigation was to evaluate the effects of moderate physical activity upon reaction time and movement time of older individuals. Specifically, the effects of participation in a five-week Folk dance program upon speed of foot response of older subjects was examined. The following research questions were studied:

1. Will a five-week program of folk dance bring about a change in simple reaction time of an older population?
2. Will a five-week program of folk dance bring about a change in movement time of an older population?

On the basis of the research questions, the following null hypotheses were developed and tested:

Null Hypotheses

1. No significant change in reaction time of older individuals will result from participation in a five-week program of folk dance.

2. No significant change in movement time of older individuals will result from participation in a five-week program of folk dance.

Delimitation

1. This study was limited to forty persons ranging in age from sixty to ninety-four years.

2. Simple reaction time was measured in thousandths of a second and movement time was measured in hundredths of a second for the right foot only.

3. No attempt was made to control the physical activity habits or the intake of drugs or medications by the subjects.

Limitations

1. There are limitations in the generalizations that can be made beyond this group of subjects.

2. Changes in reaction time or movement time that resulted from the experimental treatment were determined for

the right foot only, therefore, the generalizations that can be made beyond that criterion measure are limited.

3. The results of participation by the subjects in physical activity beyond the experimental dance class and of consumption of medicines or drugs were not monitored or measured in this investigation.

Definition of Terms

Folk Dance Class

For the purposes of this study, folk dance class referred to the instructional sessions in dance. The majority of dances used line or circle formations with simple patterns and steps.

Movement Time

Movement time consisted of the latency between the release of the starting foot switch and the depression of the target foot switch.

Senior Citizen

As defined in this study, a senior citizen referred to an individual aged sixty years or older.

Simple Reaction Time

The time elapsing between the moment of activation of a stimulus light and the moment of response was designated as simple reaction time.

CHAPTER II

REVIEW OF RELATED LITERATURE

The slowing of voluntary response with advancing age is consistently reported in the literature on aging. The role of physical activity in delaying or reducing the age effect upon speed of response has not been clearly determined. Until recently the effects of habitual physical activity and the effects of varying levels of physical fitness upon neuromuscular integrity of older individuals have been largely uninvestigated. However, researchers have implied that a relationship exists between physical exercise habits and response characteristics. For example, Pierson and Montoye (23) suggested that regular physical activity may delay or retard neuromuscular decrement.

Smith and Green (25) indicated that frequently performed movement tasks were less affected by aging than tasks infrequently performed.

Spirduso (27) concluded that vigorous sports participation appeared to be a significant factor in retarding aging effects upon voluntary neuromuscular responses.

The role of physical activity in delaying neuromuscular aging is unclear. This review examined research concerning the effects of aging upon reaction time and movement time. An attempt was made to examine factors that seemed to be associated with the slowing of voluntary

responses with increased age. In addition, dance participation was evaluated as a modality for improvement of response speed of older people.

Age Changes and Speed of Response

Simple Reaction Time

Researchers consistently reported slower reaction time for older subjects when they were compared with younger subjects (4, 7, 9, 17, 23, 27).

Birren (6) suggested that because age and reaction time were so highly related, the most productive way to study aging effects on performance was by analyzing changes in response speed.

Discriminatory Reaction Time

Researchers have studied discriminatory reaction time as a function of the excitability of the central nervous system as it related to the slowing of responses with age.

Response time for tasks requiring choice and judgment has been investigated. Deupree and Simon (9) reported that among older subjects, response time for complex tasks increased progressively as task complexity was increased.

Response time was investigated by Birren and Botwinick (4) while subjects performed a task requiring judgment. Young and elderly subjects were required to judge which of two simultaneously presented lines was shorter. A

significant difference was reported at all levels of difficulty in judgment. The response time of the older group was slower as the difference between line lengths decreased and judgments became more difficult.

Griew (12) utilized a perceptual motor task involving movements of a stylus in response to a series of lights while studying response time of a complex task. He reported that response time increased progressively as task complexity increased among older subjects.

Laufer and Schwertz (19) studied five neuromuscular response tests to evaluate their use as predictors of sensory-motor performance on a standard motion study pinboard task. With increase in age, performance changes were reported on the response tests, with more noticeable differences apparent when complexity of reaction was required. Laufer reported that among older subjects reaction time was a greater influence on the increase in total response time than was movement time.

Movement Time

Research reports are in disagreement concerning the effects of age upon speed of movement. Some results have indicated that increased reaction time accounted for a major slowing effect of age upon total response time (19, 24, 28).

However, others reported that movement time

increased with age in a manner similar to the increase in reaction time (9, 21, 23, 27).

Factors Associated With Changes in Speed of Response in Aging

Researchers have attempted to isolate the mechanisms responsible for the loss of speed of response with age. Factors that may contribute to a general slowing of voluntary responses with aging included physical activity habits, conduction velocity of peripheral nerves, and cardiovascular disease.

Physical Activity Habits

Some evidence suggests that regular physical activity may have beneficial effects in delaying the aging process in nervous tissue. The German physiologists C. and O. Vogt (29) observed that the degree of activity of a nerve cell had a great effect upon its aging process. Destruction of nerve cells which normally activate other ganglion cells caused premature aging of those cells which received fewer impulses. However, involution reportedly was delayed by physical activity. The researchers concluded that the aging of certain ganglion cells may be delayed in particularly active individuals.

Using a series of motion studies, Smith and Green (25) analyzed selected movements of older people. The researchers reported that tasks performed most regularly

were least affected by aging and showed no striking age changes until after age sixty-five. Tasks infrequently performed however, showed reduced speed among subjects under age fifty and in some cases at age thirty-five. Aging had a more marked effect upon manipulative movements such as drawing and writing which are fine motor skills than on travel movements such as walking, which is a gross motor skill.

Although researchers have consistently reported both slower reaction time and movement time for older subjects, within group comparisons have shown that individual differences exist among older subjects in the ability to react and to move quickly. Pierson and Montoye (23) reported a greater range of individual differences in response times for subjects over sixty years of age. The researchers speculated that a lifetime of physical activity may delay neuromuscular decrement in later life. Miles (21) reported that nearly one-fourth of the subjects in his "over seventy years of age" group were capable of responses similar to those of the average adult. Laufer and Schwertz (19) reported that some older subjects showed extreme results on many neuromuscular response tests. One subject over seventy years of age responded to a reaction time test as quickly as the average twenty year old.

Spirduso (27) sought to determine if individual differences in response speed were associated with physical

activity habits of older people. The researcher compared reaction time and movement time of older men who had experienced a life style of physical activity to non-active men of similar ages. Both groups were contrasted to groups of active and non-active young men. The results showed that for the older active group the average decrement in response speed that could be attributed to age was only 8 percent, while the average decrement of the older inactive group was 22.5 percent. Physical activity appeared to play a more dominant role than age in determining both reaction time and movement time. Contrary to the results of Laufer (19), Spirduso (26) indicated that age had as great an effect upon movement time as upon reaction time in total response speed. Apparently, movement time was so influenced by regular physical activity that when activity level was introduced as a variable, the age differences in movement time were of similar magnitude as differences in reaction time.

The information presented here clearly indicated the need for further investigation into the role of physical activity as a possible modifier of reaction time and movement time of older people.

Conduction Velocity of Peripheral Nerves

Age changes in the conduction velocity of peripheral nerves has received some attention in the literature on

aging. In two separate studies it was reported that conduction velocity of peripheral nerves of rats decreased with increases in age (5, 18).

Using human subjects, Norris, et al. (22) reported a decrease of conduction velocity with age in the fastest conducting fibers of the human ulnar nerve. The reduction in conduction velocity, however, accounted for only about four percent of the total reduction in speed of human reactions. The researchers therefore attributed the main effects of increased reaction time to factors other than age changes in the conduction velocity of nerves.

Birren and Botwinick (3) reported slower reaction times of the finger, jaw, and foot for older subjects when compared to a younger group. Despite the longer neural pathway for foot response, no disproportionate slowing of responses was found for the foot as compared to that of the finger or jaw. The researchers concluded that the data presented evidence suggesting that age changes in response latency was a property of the central nervous system and not of decreased velocity of peripheral impulses.

Cardiovascular Disease

Individual differences in speed of response of older people may be related to cardiovascular aging according to some reports. Abrahams and Birren (1) stated that in absence of clinical signs of pathology, persons behaviorally

predisposed by their life style to coronary heart disease had significantly slower reaction times.

Spieth (26) reported that subjects suffering from cardiovascular disease processes performed more poorly on perceptual-motor tasks than healthy subjects of similar age. The slowness of response was attributed to the decision phase of discriminatory reaction time and not to movement time. These results suggest that cardiovascular diseases had a detrimental effect upon central nervous system processing, while speed of movement was unaffected.

The Value of Dance as a Physical Activity For Improving Speed of Responses

The value of dance participation in altering the speed of response of older individuals has been largely uninvestigated. However, dance as a form of physical activity has been evaluated in terms of its potential contribution to the improvement of physical fitness measures.

Durrant (11) compared the effects of jogging, rope skipping, and aerobic dance upon body composition and maximum oxygen uptake of college women. The effect of dance was not significantly different than the effect of participating in either jogging or rope skipping. However, a significant difference was reported among the three participation groups and a control group that did not exercise.

Hays (14) compared the effects of participation in a beginning modern dance class and a gymnastics class upon selected physical fitness measures of college women. The results indicated that neither dance nor gymnastics produced a significant improvement in fitness.

The results of an investigation by Daniel, Pollock, and Smartsman (8) suggested that dance training may be one modality for improving levels of physical fitness. The subjects were young obese college women who participated in an eight-week dance training class meeting 30 minutes per session three times per week. Included in the dance program were basic locomotor movements, basic dance steps, and folk dances. The results of the analysis indicated that the group participating in dancing significantly improved in several fitness measures including resting and recovery heart rates. In addition, the analysis of body composition measures showed that the dance group significantly reduced skinfold fat and percent body fat.

Gulick (13) stated that the pulse rate while actively dancing may range from 100 to 130 beats per minute depending upon the intensity of the dancing.

In reporting energy cost of selected activities Astrand (2) indicated that the energy cost of dancing ranged from 4.5 to 7.5 kilocalories per minute. Comparatively, walking at the rate of four miles per hour required an energy output of from 3.25 to 7.0 kilocalories per minute.

Evidence is conflicting regarding dance as an activity for the improvement of physical fitness of younger individuals. However, older people who are typically less physically active than the young may receive benefits of greater magnitude from the participation in a moderate activity such as dance.

Measurement of Reaction Time and Movement Time

In the literature concerning the effects of aging upon reaction time and movement time there was a predominance of studies analyzing responses of the hand and arm to a light stimulus. Abrahams and Birren (1) utilized a forward movement of the hand as criterion measure for simple reaction time of older subjects. After a brief warning period a red stimulus light signaled the subject to move the hand forward and depress a key. Following fifteen practice trials, fifty test trials were recorded. The experimental design included one-way analysis of variance for each reaction time condition. The independent variable was the behavioral condition while the dependent variables were simple and choice reaction time.

In an investigation by Pierson and Montoye (23) the effects of age upon reaction time and movement time were studied using a response of the hand and arm. The subject was instructed to respond to a light stimulus by thrusting

the hand forward to interrupt a light beam. Following a two-second preparatory signal the stimulus light and a chronoscope were simultaneously activated. The subject responded by releasing a microswitch and moving the hand through the light beam placed eleven inches in front of him. The last fifteen of thirty trials were used in the analysis.

Spirduso (27) studied the effects of age and activity level upon simple reaction time, discriminatory reaction time, and movement time utilizing a movement of the hand and arm. Following a foreperiod of from 1.5 to 3.0 seconds a red stimulus light was activated. The subjects responded by moving the hand from a microswitch to a target microswitch. Fifteen trials were administered and the last ten trials were used in the analysis. The data were analyzed using a three-factor design with repeated measures on one factor. The two independent factors were age and sports activity level. The within-subject variable was the subjects' test trials on reaction time and movement time.

Birren and Botwinick (3) studied auditory reaction time of the finger, jaw, and foot. Following a warning interval varying from one to six seconds a 1000 cycle tone was delivered through earphones to start the test. Each subject performed a total of 150 trials with 50 trials each for the finger, jaw, and foot. In a separate report Botwinick, et al. (7) analyzed a warning interval length and its influence upon reaction time of older individuals.

The researchers reported a significant relationship between length of the warning interval and reaction time. For the elderly a one-second warning interval resulted in a mean reaction time of .31 seconds, while a six second delay resulted in a mean reaction time score of .22 second. These results suggested that warning interval length was a variable that should be controlled in order to obtain more consistent measures of reaction time for older subjects.

Individual differences among older subjects in their performances on reaction time and movement time tests were consistently reported (19, 21, 23, 27). Pierson and Montoye (23) stated that inter-individual differences increased greatly among subjects over sixty years of age. These performance differences among the aged were reflected in the reported means and standard deviations for reaction time and movement time. The mean scores reported for simple reaction time of older subjects ranged from .220 to .327 seconds with standard deviations ranging from .028 to .110 seconds. Reported movement time means for older subjects ranged from .149 to .380 seconds with standard deviations ranging from .029 to .120 seconds (1, 23, 27).

Summary

The research on aging identified the characteristic slowing of responses with advancing age. More specifically, both simple and discriminatory reaction time were clearly

related to age. Age changes in movement time, however, were not universally reported.

Attempts were made to isolate factors responsible for age change in response speed. In the absence of data implicating a peripheral mechanism such as conduction velocity of peripheral nerves, it appeared that age changes in the excitability of the central nervous system accounted for much of the slowing of response.

Mode of life and the nature of daily activity appeared to influence behavior in terms of the quality and speed of movement among the aged. It was shown that tasks frequently performed were least affected by aging, while tasks performed infrequently showed early reductions in speed.

Among heterogeneous populations of older individuals, time of perception appeared to be more important to the change of total response speed than was actual speed of movement. However, when homogeneous groups of older, physically active individuals were considered, changes in movement time were of similar magnitude as changes in reaction time in the total speed of response. Some evidence suggested that physical activity played a more dominant role than age in determining the speed of responses.

Dance was evaluated for its contribution to the improvement of physical fitness measures of college students. Although reports were in disagreement concerning the merit of dance as a conditioning activity for the young, the

potential of dance participation as an activity for the elderly was largely uninvestigated.

Some considerations were given to the varied measurement techniques used by researchers. Several studies of reaction time, movement time and age were conducted utilizing hand and arm movements in response to a light stimulus. The numbers of trials used in the analyses varied from ten to fifty trials for a test movement.

The length of the warning interval appeared to be a variable that required control in order to assure consistent measures of reaction time for older subjects, according to the literature concerning the length of warning interval and its effect on reaction time.

Inter-individual differences existed among older subjects in performance on reaction time and movement time tests. These differences were reflected in the means and standard deviations reported in the literature on response speed in aging.

CHAPTER III

METHODOLOGY

The literature on aging revealed deficits in rate of neuromuscular response for older individuals when compared to the young. Recently, physical activity was suggested as a factor influencing neuromuscular performance in later years. The intent of this investigation was to determine whether participation in the physical activity of folk dancing would significantly influence the speed of response and speed of movement of older individuals.

The data for this research were collected at the Senior Citizens' Center of Corvallis, Oregon, and the dissertation was completed at Oregon State University during the 1975-77 academic years.

Subjects

The subjects were forty volunteers aged sixty years and older residing in Corvallis, Oregon. The experimental group contained twenty volunteers from the folk dance class taught by the experimentor. The dance class was publicized by distributing posters, and by making announcements at several functions at the Senior Citizens' Center. During the initial meetings of the dance class the experimentor explained the project, asked for volunteers, and scheduled the testing of subjects. The control group consisted of

twenty volunteers from the Senior Citizens' Center who did not participate in the dance class. Control subjects were sought by advertising through posters and by announcing the class at senior citizen functions and inviting control subjects.

Demographic data including age, height, weight, and physical activity status were obtained for each subject. The form used for the collection of this information appears in Appendix A. Appendix B contains the form granting approval for the use of human subjects by the Oregon State University Committee for the Protection of Human Subjects. Included in Appendix C is the form describing the nature of the research project. The forms used to obtain written consent of the subjects for participation in either the control group or the experimental group appear in Appendix D.

Instrumentation

A Lafayette model 54015 digital stop clock, a Lafayette model 54119 clock counter, a Lafayette model S63502 hand sensor, a Lafayette model S63503 foot sensor, and a Lafayette Visual Choice reaction time apparatus model 63035 were used in the collection of data.

For testing, the subject sat in a straight chair with a back support. Initially, the right foot was placed on the starting foot switch (hand sensor) located twelve inches to the front and three inches to the right of the mid line of the front of the chair. The target foot switch (foot

sensor) was placed six inches to the left of the starting foot switch. Specific information regarding the arrangement of the testing equipment is depicted in Figures 1 and 2.

In an attempt to prevent extraneous visual stimulation, the testing station was positioned so that the box containing the stimulus light was visible to the subject against a blank wall. The clocks, cords, and the experimentor were out of the range of vision of the subject. In an attempt to control motivation, trial results were withheld until the data were collected.

Measurement Techniques

Prior to each trial a warning period began as the experimentor stated the word, "ready." The length of the warning period varied from two to four seconds by advance random assignment. Using a clock with a sweep second hand the experimentor timed the warning period. At the end of the warning period the starting button was pressed by the experimentor which activated the reaction time clock and the stimulus light simultaneously. Reaction time started at the onset of the stimulus light and was clocked until the right foot was lifted from the starting foot switch. Movement time started as the foot was lifted and was clocked until the foot pressed the target foot switch. Reaction time was measured in thousandths of a second, while movement time was measured in hundredths of a second. In an attempt

Figure 1. Subject in Position for Reaction Time and Movement Time Test.

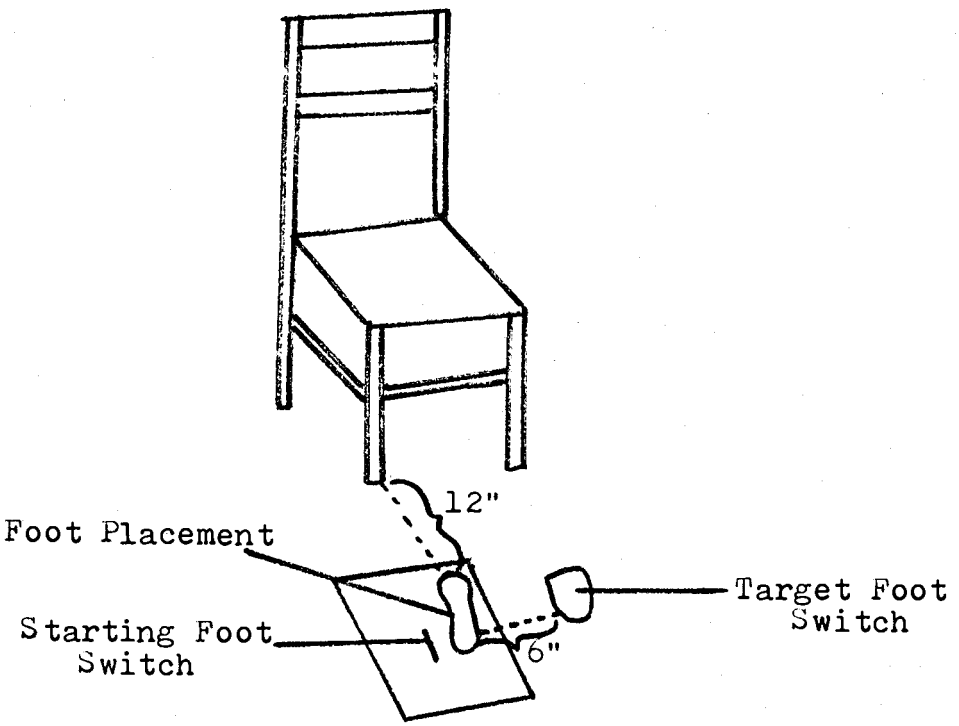

Figure 2. Diagram of Testing Station

to eliminate the early effects of learning, fifteen trials were given and the last ten were recorded. The high and low recorded scores were eliminated from the ten and the remaining eight scores were used as criterion measures. The procedures were repeated for the post-test.

Dance Program

The twenty experimental subjects participated in a folk dance class that met for sixty minutes twice a week for a period of five weeks. The dances included a variety of international folk dances that were taught by the experimentor. The general procedures included beginning and ending with the least vigorous dances. The dances containing more active movements were performed in the middle portion of the session. Rest periods were provided after more vigorous dances, and chairs were provided so that the dancers could sit and rest when necessary. The decisions on the frequency and duration of the dance classes were based upon the availability of the facilities, the schedule of the activities at the Senior Citizens' Center, and the experimentor's judgment.

Figure 3 illustrates a folk dance class during a typical session. The dances included in the folk dance program were included in the list below:

Day	1	Teton Mountain Stomp (Modified) Green Sleeves Virginia Reel	Day	2	Green Sleeves Virginia Reel Oh Susannah Chimes of Dunkirk
Day	3	Oh Susannah Cshesbogar (Modified) Virginia Reel Green Sleeves	Day	4	Oh Susannah Virginia Reel Teton Mountain Stomp Basic Polka Step
Day	5	Cshesbogar Chimes of Dunkirk Polka Step Glow Worm	Day	6	Oh Susannah Glow Worm Polka Step Green Sleeves
Day	7	Cshesbogar Chimes of Dunkirk Polka Step Glow Worm	Day	8	Oh Susannah Glow Worm Lazy Robin Teton Mountain Stomp
Day	9	Basic Waltz Step Chimes of Dunkirk Cshesbogar Polka Step	Day	10	Basic Waltz Step Spanish Circle Waltz Oh Susannah Cshesbogar
Day	11	Spanish Circle Waltz Green Sleeves Cotton Eyed Joe Glow Worm	Day	12	Cshesbogar Crested Hen Sudmalinas

Figure 3. Illustration of a Folk Dance Class in Session.

Experimental Design

The experimental design was a group by trials analysis of variance with F for groups, for trials, and for groups by trials interaction as shown in Figures 4 and 5. If a significant F for groups occurred, the results were interpreted to mean that the groups were significantly different in reaction time or movement time. If a significant F for trials occurred, the results indicated a significant difference between pre-test and post-test means. Finally, if the interaction term was significant the results indicated that the groups changed significantly by trials.

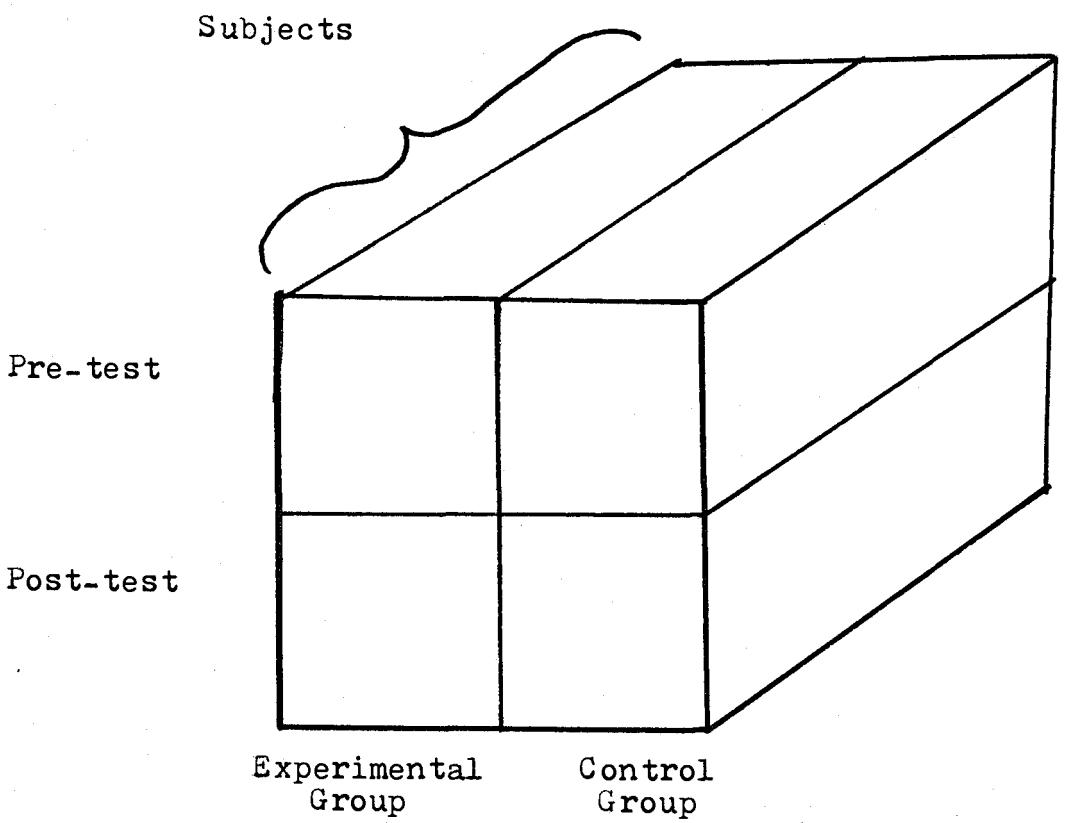

Figure 4. Experimental Model of Groups by Trials Analysis of Variance.

Variable	Sum of Squares	d.f.	Mean Squares	F-Ratio
Main Effects				
Group				
Trial				
2-Way Interactions				
Group-Trial				
Explained				
Residual				
Total				

Figure 5. Groups by Trials Analysis of Variance

CHAPTER IV

RESULTS AND DISCUSSION

The effects of participation in a five-week folk dance program upon reaction time and movement time of older individuals was studied in this investigation. The criterion test included a simple movement of the right foot in response to a light stimulus. The experimental condition was the participation by experimental subjects in a folk dance class meeting twice a week for five weeks. Results were determined using a groups by trials analysis of variance.

Descriptive Statistics and Reliability Coefficients

Subjects

Forty individuals aged sixty to ninety-four served as subjects with eighteen females and two males per group. The control group with mean age 70.8 contained eighteen subjects that were right dominant and two that were right and left dominant. The experimental group with mean age 71.1 included nineteen right dominant subjects and one that was right and left dominant. Eight control subjects indicated past experience in dance or physical activity, and seven controls stated that they currently danced regularly. Thirteen experimental subjects noted past

experience in physical activity and dance, and seven experimentals danced regularly in settings other than the experimental folk dance class.

Reaction Time

Reaction Time was measured using five practice trials and ten recorded trials of foot response. The high and low recorded trials were eliminated from the ten and the average of the remaining eight trials was used in the analysis. The data are presented in Figure 6 and Table I.

The mean scores of reaction time for the experimental group were .322 seconds on the pre-test and .326 seconds on the post-test. The pre and post-test standard deviations for experimentals were .039 and .042 seconds, respectively. These values fall within the range of means and of standard deviations for reaction time of older subjects reported by other researchers (1, 23, 27). The performances of the control group in pre-test reaction time yielded a mean score of .376 seconds with a standard deviation of .160 seconds which were both outside the range of scores reported by other investigators. On the post-test mean reaction time score for the control group was .332 seconds which was outside the expected range. The standard deviation for control group reaction time was .056 seconds which was similar to the results of other researchers (1, 23, 27).

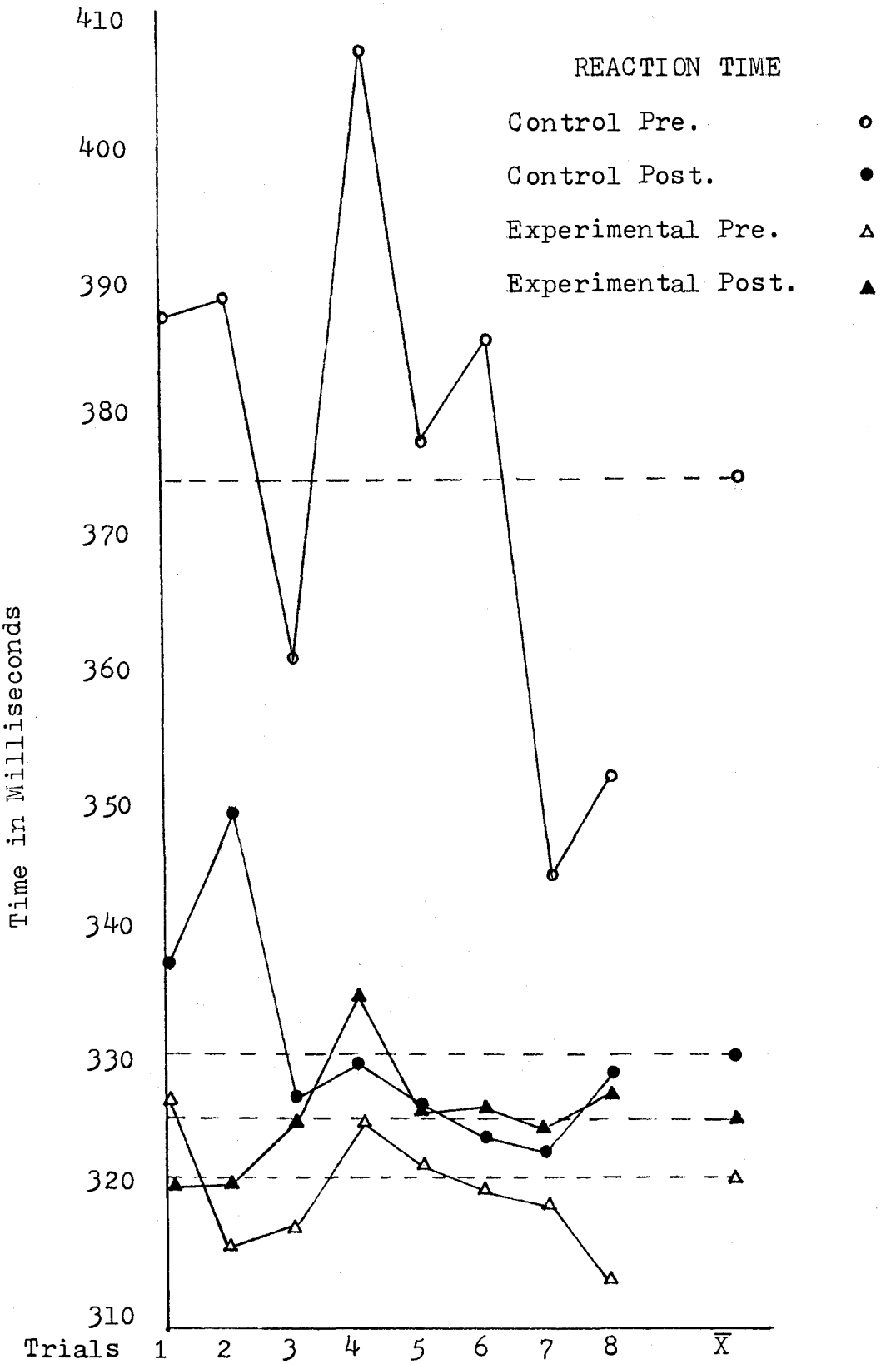

Figure 6. Reaction Time Trial Means and Group Means on the Pre-test and Post-test.

Table I. Reaction Time Trial Means, Standard Deviations, Correlation Coefficients[a], Group Means, and Group Standard Deviations for the Pre-test and Post-test.

	Experimental Group		Control Group	
Trial	Pre-test (Milliseconds)	Post-test	Pre-test (Milliseconds)	Post-test
1 $\bar{X}$	328	321	389	338
1 SD	060	030	199	078
1 r	.61	.65	.99	.90
2 $\bar{X}$	316	321	390	350
2 SD	041	040	210	102
2 r	.09	.76	.99	.93
3 $\bar{X}$	318	326	362	328
3 SD	054	053	096	066
3 r	.82	.92	.89	.89
4 $\bar{X}$	327	336	409	331
4 SD	064	057	267	054
4 r	.71	.88	.99	.77
5 $\bar{X}$	323	327	379	327
5 SD	045	065	183	085
5 r	.80	.87	.99	.85
6 $\bar{X}$	321	327	388	325
6 SD	046	053	180	051
6 r	.85	.92	.96	.84
7 $\bar{X}$	320	326	344	324
7 SD	052	042	077	057
7 r	.74	.65	.90	.79
8 $\bar{X}$	314	329	353	330
8 SD	041	063	104	060
8 r	.75	.88	.97	.77
Group $\bar{X}$	322	326	376	332
Group SD	039	042	160	056

[a] r of .54 is required for .01 level of significance

Group average reaction time scores were correlated with the eight respective trial scores to determine measurement consistency. Inspection of Table I shows that the resulting correlation coefficients ranged from .90 to .99 for the control group while the correlation coefficients for the experimental group ranged from .61 to .90. The average score was therefore selected as criterion measure for reaction time.

Movement Time

Movement Time was measured using five practice and ten recorded trials. After eliminating the high and low recorded trials from the ten, the average of the remaining eight was analyzed. Movement time data are presented in Figure 7 and Table II.

The mean movement time scores for the two groups ranged from .262 to .382 seconds, and these results fell within the range reported by other researchers (1, 23, 27). The standard deviations of the experimental group for pre-test and post-test movement time were .053 second and .051 second respectively, and these fell within the expected range. The standard deviation for control group movement time on the pre-test was .230 second which was outside the expected range of scores. However the post-test standard deviation for control group movement time was .110 second and was similar to scores reported by other investigators (1, 23, 27).

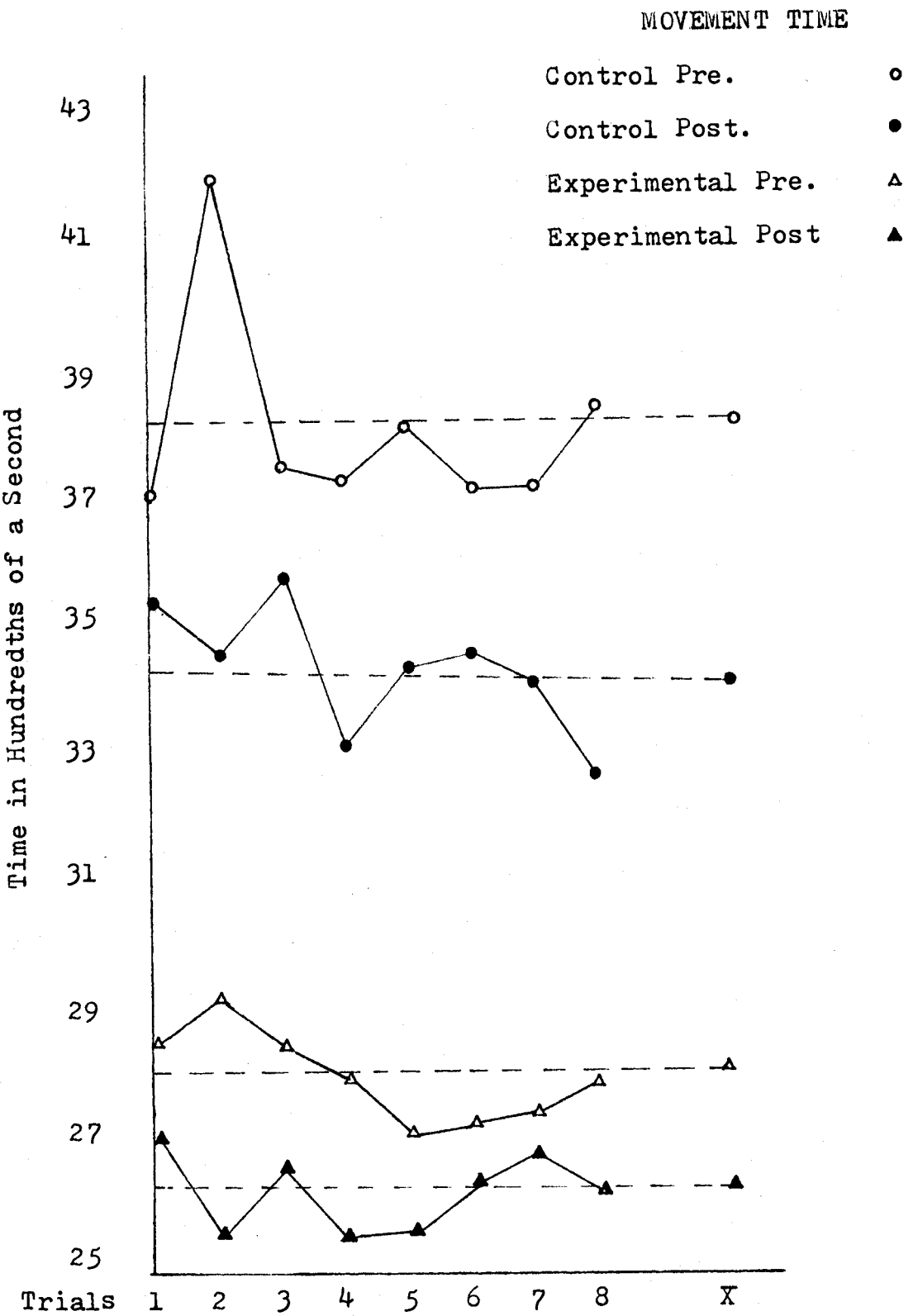

Figure 7. Movement Time Trial Means and Group Means on the Pre-test and Post-test.

Table II. Movement Time Trial Means, Standard Deviations, Correlation Coefficients[a], Group Means and Group Standard Deviations for the Pre-test and Post-test.

Trial		Experimental Group		Control Group	
		Pre-test	Post-test	Pre-test	Post-test
		(Hundredths of seconds)		(Hundredths of seconds)	
1	$\bar{X}$	286	272	372	355
	SD	059	072	200	122
	r	.90	.84	.97	.91
2	$\bar{X}$	293	256	422	347
	SD	059	054	335	127
	r	.85	.95	.98	.97
3	$\bar{X}$	285	266	376	359
	SD	059	052	252	140
	r	.87	.88	.99	.94
4	$\bar{X}$	280	256	374	332
	SD	053	050	199	113
	r	.94	.86	.96	.94
5	$\bar{X}$	271	256	383	345
	SD	058	056	212	099
	r	.94	.94	.97	.93
6	$\bar{X}$	272	264	373	346
	SD	055	057	205	118
	r	.94	.93	.99	.89
7	$\bar{X}$	274	269	373	342
	SD	059	061	232	119
	r	.84	.87	.99	.97
8	$\bar{X}$	279	262	386	328
	SD	060	079	236	094
	r	.89	.73	.99	.96
Group	$\bar{X}$	281	262	383	343
Group	SD	053	051	230	110

[a] r of .54 is required for .01 level of significance

Measurement consistency for movement time was evaluated using a correlation analysis of group average scores with the respective eight trial scores. As indicated in Table II, the coefficients for the control group ranged from .96 to .99 while the coefficients for the experimental group ranged from .73 to .95. Therefore the group average score was selected as criterion measure for movement time.

Initial Groups Comparison

Reaction Time

Initial reaction time measures were analyzed to determine whether groups were significantly different at the onset. No significant difference was found between group means in pre-test reaction time as indicated by the resulting $F = 2.21$. (See Table III.) The control subjects demonstrated greater variability about the pre-test reaction time mean with a standard deviation of .160 second, while the experimentals responded with a standard deviation of .039 second (Table I).

Movement Time

The groups were not significantly different in pre-test movement time as evidenced by the resulting $F = 3.74$, where $F = 4.08$ was required for significance at the .05 level. These results can be seen in Table III.

Table III. Analysis of Variance using Pre-test Group Average Scores.

Variable		Sum of Squares	d.f.	Mean Square	F-Ratio
Reaction Time	Between	.030	1	.030	2.21[a]
	Within	.514	38	.014	
	Total	.543	39		
Movement Time	Between	.10	1	.10	3.74[a]
	Within	1.06	38	.03	
	Total	1.16	39		

[a] F of 4.08 with 1 and 39 d.f. required for P = .05

Post-Test Data

Reaction Time

Trial means, standard deviations, and correlation coefficients resulting from a trial mean to group mean correlation analysis appear in Table I. The coefficients of correlation for the control group ranged from .77 to .93, while the coefficients for the experimental group ranged from .65 to .92.

Movement Time

Trial means, standard deviations, and correlation coefficients for post-test movement time data are included in Table II. The correlation analysis of trial means to group means produced coefficients ranging from .89 to .97 for the control group and from .73 to .95 for the experimental group.

Effect of Folk Dance Participation Upon Reaction Time and Movement Time

The effect of folk dance participation upon reaction time and movement time was evaluated using a groups by trials analysis of variance. The results are presented graphically in Figures 6 and 7 with the variance analysis appearing in Table IV.

Reaction Time

The main effects of groups and of trials were not

Table IV. Analysis of Variance Attributable to Participation in Folk Dance.

Variable		Sum of Squares	d.f.	Mean Square	F-Ratio
Reaction Time	Main Effects	.026	2	.013	1.63
	Group	.018	1	.018	2.24
	Trial	.008	1	.008	1.02
	2-Way Interactions	.012	1	.012	1.54
	Group-Trial	.012	1	.012	1.54
	Explained	.038	3	.013	1.60
	Residual	.607	76	.008	
	Total	.646	79	.008	
Movement Time	Main Effects	.183	2	.092	5.21[a]
	Group	.167	1	.167	9.48[a]
	Trial	.017	1	.017	0.94
	2-Way Interactions	.002	1	.002	0.13
	Group Trial	.002	1	.002	0.13
	Explained	.185	3	.062	3.52[b]
	Residual	1.34	76	.018	
	Total	1.52	79	.019	

[a] F of 3.96 with 1 and 79 degrees of freedom is required for the .05 level of significance

[b] F of 2.72 with 3 and 79 degrees of freedom is required for the .05 level of significance

significant indicating that five weeks of folk dancing did not significantly effect reaction time of foot response in this group of older subjects. As shown in Table II the control subjects reacted faster on the post-test than on the pre-test, although this difference was not significant. Conversely the experimental subjects had a slight increase in reaction time on the post-test.

Movement Time

A significant F value resulted for main effects and for differences between groups in movement time. However, no significant difference between trials resulted from this analysis. Both groups performed faster on the post-test than on the pre-test.

Comparison of Pre-test to Post-test Difference Scores

To provide a second opportunity to examine the data, changes in reaction time and movement time were analyzed using a one way analysis of variance. Performance changes in both reaction time and movement time were determined by subtracting the post-test average scores from the pre-test average scores. These pre-test to post-test difference scores were then statistically analyzed.

Reaction Time

The pre-test to post-test difference scores in

reaction time were not significantly different as shown by the F-ratio of 3.38. An F = 4.08 was required for significance at the .05 level (Table V).

Movement Time

Comparison of the difference scores for movement time yielded an F-ratio of .373 which was not statistically significant. These results appear in Table V.

Relationships Between Reaction Time and Movement Time

The reaction time movement time relationship was studied within each group using post-test data. This analysis produced a coefficient of r = .94 for control subjects. The reaction time-movement time correlation analysis for experimental subjects resulted in a coefficient of .02.

Discussion

With neuromuscular performance decrement typically associated with aging, the maximum rate of response of the older individual diminishes with advancing age. Recently, researchers examined physical activity as a possible factor influencing the aging process as it relates to motor behavior. The main purpose of this investigation was to determine whether neuromuscular capacities of older individuals as specific as reaction time and movement time

Table V. Analysis of Variance Attributable to Participation in Folk Dance Using Difference Scores.

Variable		Sum of Squares	d.f.	Mean Square	F-Ratio
Reaction Time	Between	.025	1	.025	3.38[a]
	Within	.276	38	.007	
	Total	.301	39		
Movement Time	Between	.005	1	.005	0.373[a]
	Within	.471	38	.012	
	Total	.475	39		

[a]F of 4.08 with 1 and 39 d.f. required for P = .05

would be altered as a result of participating in a physical activity as general as folk dancing. For this main purpose the hypotheses of the investigation were developed and tested. Interpretation of the data will be presented firstly in relation to the hypotheses stated in Chapter I and secondly in terms of the more specific findings.

Hypothesis one, that no significant change in speed of reaction of older individuals will result from participation in a five-week program of folk dance was accepted on the basis of an F of 1.63 for main effects which was not statistically significant. None of the resulting F-ratios for groups, trials or groups by trials interaction were significant.

Hypothesis two, that no significant change in speed of movement of older individuals would result from participation in a five-week program of folk dancing, was accepted. The F ratio for main effects was 5.21 which was significant at the .05 level. The analysis furthermore produced a significant F of 9.48 for differences between groups in movement time. However, there was no significant difference between trials for movement time according to the resulting F for trials of 0.94, therefore acceptance of the null hypothesis appeared justified.

The significant difference found for groups but not for trials in movement time warrants some consideration. The significant differences in movement time that resulted

for both main effects and for groups implied that an alteration in the movement pattern had occurred following the experimental treatment. The use of a larger number of cases when both pre-test and post-test data were considered together tended to amplify the results making the difference for groups significant. However, when post-test data were considered alone, the smaller number of cases may have attenuated the results producing an insignificant F value. In view of this consideration, larger numbers of subjects would be recommended for future investigations of the effect of folk dance training upon reaction time and movement time of older individuals.

Inter-individual performance difference as reflected by the standard deviations about the group means bears some consideration. Tables I and II reveal that the standard deviations of the control group for both reaction time and movement time were larger than the standard deviations of the experimental group for both criterion measures. These results suggest that the group of individuals that did not select to participate in the folk dance class had broader ranges of response in reaction time and movement time than had the group that chose to join the dance class.

In examining the influence of physical activity level upon reaction time and movement time, Spirduso (27) reported larger standard deviations for the older physically

inactive group than for the older physically active group. Moreover, the habitually physically active group of older individuals in the Spirduso study were significantly quicker in both reaction time and movement time than the older group of subjects classified as habitually physically inactive.

The results suggest that groups of older individuals who are habitually physically active not only react and move more quickly, but also respond with a more confined range of inter-individual differences in both reaction time and movement time. These results suggest the need for controlling the factors of past experience and of inclination toward physical activity in future investigations of the effect of physical activity upon reaction time and movement time.

The pre-test to post-test difference scores for reaction time and movement time were analyzed in order to provide a second opportunity to examine the data and to minimize the risk of committing a type II error due to small group sampling. Neither the pre-post differences in reaction time nor movement time were statistically different.

Finally, to amplify the results of this investigation the post-test data were studied using a correlation analysis to examine the reaction time/movement time relationship for both groups following the experimental treatment. The correlation coefficient that resulted for the control group was $r = .94$ indicating strong relationship between reaction time and movement time for that group. These results are

in contrast with the results of other investigators who reported that reaction time and movement time were largely independent (16, 17). Other researchers reported that coefficients of correlation for reaction time and movement time tend to be higher in groups that were heterogeneous with respect to age (19, 23).

The correlation analysis for the experimental group yielded a coefficient of $r = .02$ which implies absence of strong relationship between reaction time and movement time for that group.

It is difficult to explain the contrasting results relative to the strength of the reaction time-movement time relationship. It appears that the experimental treatment, participating in five weeks of folk dancing, had produced an effect upon the movement pattern of the experimental subjects that was not clearly defined in the results of the reaction time and movement time tests or in the results of the correlation analysis.

In summary, the results suggest that the participation in physical activity as general as folk dancing had no statistically significant effect upon the reaction time and movement time of senior citizens.

This writer recommends that future research efforts be directed toward the study of the effects of physical activity upon reaction time and movement time of older individuals. It is suggested that consideration be given

to controlling the factors of past experience and of inclination toward physical activity in attempting to evaluate the changes in reaction time and movement time resulting from the participation in a program of physical activity.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The research in the literature on aging has identified characteristic slowing of responses with advancing age. Mode of life and nature of daily activity have recently been studied as possible influences upon the quality and speed of movement and upon reaction time of older individuals.

The purpose of this study was to evaluate the effects of participation in a folk dance class upon the reaction time and movement time of older individuals. Two hypotheses were developed and tested. These were:

1. No significant change in reaction speed of older individuals will result from participation in a five-week program of folk dance.

2. No significant change in movement speed of older individuals will result from participation in a five week program of folk dance.

This investigation examined the effects of participation in the physical activity of folk dancing upon reaction time and movement time of older individuals. The criterion measures were reaction time and movement time of the right foot. The experimental condition was a five-week instructional class in folk dancing.

Experimental Equipment

The equipment used to measure reaction time and movement time included the following Lafayette models: 54015 digital stop clock, 54419 clock counter, S63502 hand sensor, S63503 foot sensor, and 63035 visual choice reaction time clock.

Experimental Procedures

Forty subjects ranging in age from sixty to ninety-four volunteered to participate in this study. All subjects were measured for reaction time and movement time of the right foot. The twenty experimental subjects participated in the folk dance class for five weeks. Finally, all subjects were remeasured for reaction time and movement time.

Analysis of Data

The data were analyzed using a groups by trials analysis of variance to determine whether the experimental treatment had significantly effected reaction time and movement time.

Results

Hypothesis 1, that no significant change in speed of reaction would occur as a result of participation in a five-week program of folk dancing, was accepted on the basis of an F of 1.63 which was not statistically significant.

Hypothesis 2, that no significant change in speed of movement of older individuals would result from participation

in a five-week program of folk dancing, was accepted on the basis of a nonsignificant F-ratio of 0.94 for trials. These results suggested that participation in five weeks of folk dancing had produced no significant effect upon the movement patterns of older individuals.

In future research concerning folk dance as a potential modifier of reaction time or movement time the writer recommends that performance tests be administered both five weeks and ten weeks after initiating the dance program.

Conclusions

Within the limits of this investigation it is concluded that the participation in folk dancing has no apparent effect upon reaction time or movement time as defined in this experiment. It is concluded that the participation in five-weeks of folk dancing was not of sufficient stimulation to bring about a modification of reaction time or movement time of senior citizens.

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APPENDIX A

Subject Information Sheet

Name _____ Date _____

Age _____ Address _____

Height _____ Phone Number _____

Weight _____

Right or Left Handed _____

General State of Health (circle one) Excellent, Good, Fair, Poor

Present or Past Occupation(s) _____

Hobbies _____

Do you have any health problems that may limit your participation in dance? If so, will you please comment on them.

_____

Do you participate in any sport or physical activity regularly? If so, will you identify them and indicate how often you participate?

	Activity	How long	How Frequent
Example	Golf	10 years	Twice a week
	_____	_____	_____
	_____	_____	_____

Do you drive an automobile? _____

If you do not drive now, have you ever driven an automobile?

_____.

APPENDIX B

OREGON STATE UNIVERSITY

Committee for Protection of Human Subjects

Chairman's Summary of Review

Title: The Effect of Folk Dancing Upon the Reaction Time and Movement Time of Older Individuals

Program Director: Dr. Donald Campbell

Recommendation:

__x__ Approval

____ Provisional Approval

____ Disapproval

____ No Action

Remarks: 1. Subjects who are involved in the study should do so with the concurrence of their physician, since moderate physical exertion will be involved. 2. Prior to asking for informed consent from the respondents, the investigators should explain that the information provided by completing the questionnaire will remain, so far as is possible, anonymous.

Date: July 7, 1976 Signature: _____
Donald L. MacDonald

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

APPENDIX C

Description of the Research Project

To complete a requirement for a doctoral degree at Oregon State University Marie Boarman is conducting a research project during the months of June, July, and August, 1976. The purpose of the project is to determine the effects of participation in a 5-week Folk dance class upon the speed of foot responses of people 55 years and older. As a volunteer member of the experimental group your participation in the following activities is requested:

1. Participation in the Pre-test for reaction time and movement time of the right foot.
2. Participation in a 5-week Folk dance class which meets on Monday and Thursday at 10:00 a.m. Each class will last approximately 60 minutes.
3. Participation in the Post-test reaction time and movement time of the right foot. The Post-test will take place 5-weeks after pre-testing.

The pre-test and post-test for reaction time and movement time are identical. You will be seated in a chair for the test. The test movement is very similar to the movement of the right foot from the gas pedal to the brake in an automobile. For each test the movement will be timed ten times after five practice trials. The time required for the pre-test and post-test is approximately 15 minutes each.

The Folk dance class will be both mildly and moderately physically active and may be a source of enjoyment and of physical exercise. You may wish to consult your physician to be sure that physical activity in the form of

Folk dance is appropriate for you.

Please be aware that you may discontinue participating in this research project at any time. Please feel free to ask any question that you may have about the project.

APPENDIX D

EXPERIMENTAL

Subject Consent Form

Having read the description of the research project to be conducted by Marie Boarman during the summer of 1976, I, _____ hereby agree to serve as an experimental subject. I will agree to participate in both the pre-test and the post-test. In addition, I will attend the Folk dance class which meets each Monday and Thursday at 10:00 a.m. for 5 weeks.

Signature _____

Date _____

CONTROL

Subject Consent Form

Having read the description of the research project to be conducted by Marie Boarman during the summer of 1976, I, _____ hereby agree to serve as a control subject. I will agree to participate in the pre-test and the post-test.

Signature _____

Date _____