Bingo vs. physical intervention in stimulating short-term cognition in Alzheimer's disease patients

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Abstract

Past research has shown that pharmacological measures can enhance cognitive and functional capacities for patients with Alzheimer's disease, but may result in unacceptable side effects. Investigations using nonpharmacological treatments are limited. This study evaluates the therapeutic effect of the game of Bingo as cognitive stimulation, versus daily physical activity, on short-term memory, concentration, word retrieval, and word recognition. Informed consent was obtained from the designated representatives of 50 subjects from six community adult day care centers on Long Island. The results show that cognitive stimulation enhanced performance on the Boston Naming Test and a Word List Recognition Task; physical intervention, however, did not reach statistical significance. Thus, a simple cognitive activity such as Bingo can be of great value to the daily management of Alzheimer's patients.

Introduction

In contrast to the growing literature on pharmacologic measures proposed to treat Alzheimer's disease (AD), there is a dearth of documentation on the benefits of nonpharmacological treatments.[1-6] This comparative study was designed to evaluate the therapeutic effect of Bingo, versus daily physical activity, to stimulate cognitive processes—short-term memory, concentration, word retrieval, and word recognition. Currently Bingo is used in adult day care programs, assisted living facilities, and nursing homes for purely recreational purposes, but attributed no therapeutic value. Since Bingo is an activity that requires multiple thought processes, it was hypothesized that, as a means of cognitive stimulation, it would be more effective than physical intervention in enhancing cognition.

Bingo stimulates many areas within the cognitive apparatus including attention, focus, concentration, and immediate memory. It involves visual and auditory perception, and it requires accurate motor movement to place the pieces on the Bingo card. Winning the game is a reinforcing reward mechanism for receiving, interpreting, and translating the stimulation into an accurate choice of motor responses. In addition, Bingo is neither threatening nor overly challenging. It provides social and community interaction and a means to escape the self-isolation so prevalent in this domain. Finally, Bingo can be utilized by a large population, requires little staffing, and provides an efficient low-cost activity of potentially therapeutic value.

Methods

All patients enrolled in the six adult day care programs on Long Island, New York, were considered for participation in the study. Inclusion criteria were a clinical diagnosis of Alzheimer's disease, current Mini-Mental Status Examination (MMSE) scores between 8 and 24, age 65 or older, English-speaking, and ambulatory. Both male and female subjects were considered. Consent for a subject's participation in the study was obtained from the patient's designated representative, since the patients were cognitively disabled. Fifty subjects were enrolled for participation from November 1998 through January 1999. Additional data was collected on each subject, including duration of cognitive impairment, level of education, and degree of physical debilitation, as well as current and past occupations, hobbies, and interests. During this investigation, patients continued their

Benjamin P. Sobel, Princeton University, Princeton, New Jersey, recipient of American Psychological Association 2000 Excellence in Research Awards, June 2000. This paper was presented at the Intel Science Talent Search, December 1999; St. John's Junior Science and Humanities Symposium, December 1999; and the ShipleyRonal Invitational Science and Engineering Fair, May 2000.

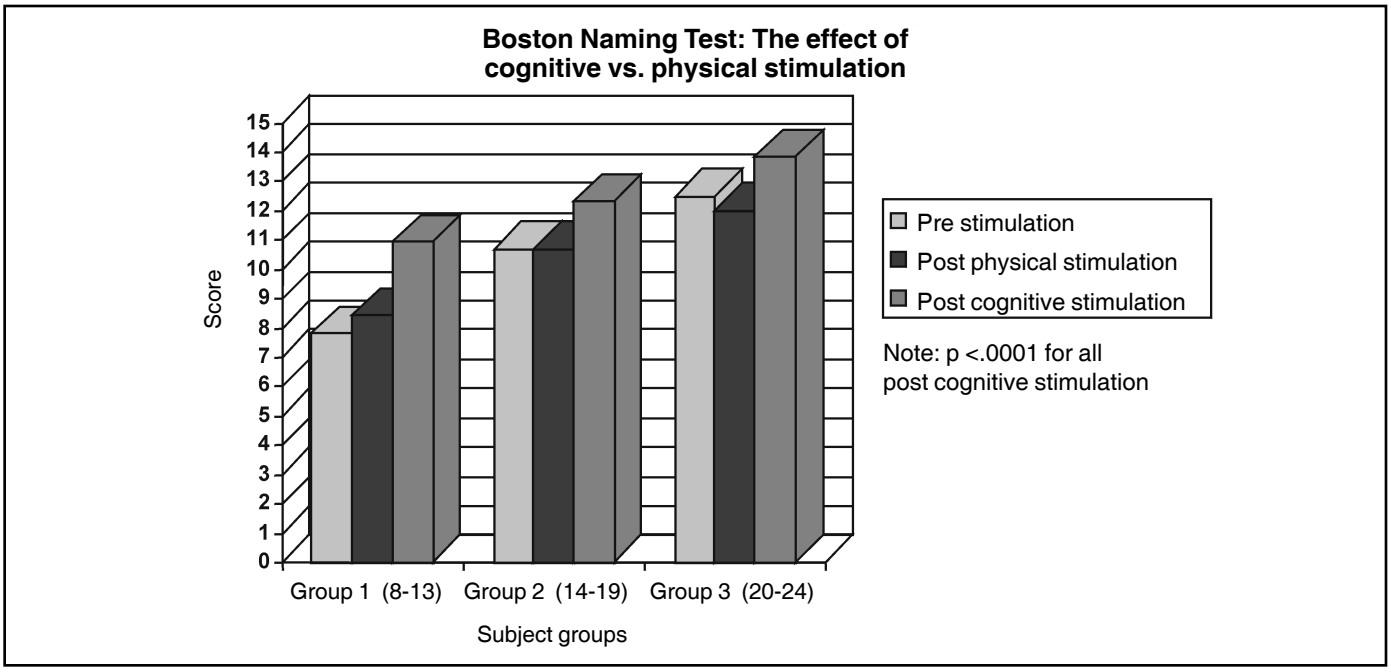

Figure 1. Comparison of scores prior to and following cognitive or physical intervention. (Maximum possible score 15. Subjects grouped according to their MMSE scores.)

scheduled activities at their respective day care programs. Such activities included cognitive stimulation tasks, *e.g.*, arts and crafts, anagrams and Bingo, as well as forms of physical intervention such as dancing and exercise.

The subjects participated in the study on two separate days for an average of 45 minutes each day. On the first day, they entered the day care center and began their usual programs. The author greeted each individual prior to any testing. In a one-on-one interview with the author, the subject then completed the Boston Naming Test (Figure 1) and a Word List Recognition Task (Figure 2), both taken from the CERAD neuropsychology battery of tests.[7] The Boston Naming Test consists of 15 common objects presented as line drawings. As a test of language ability and word retrieval, each subject was asked to provide a name for each picture. The Word List Recognition Task asks requires the subject to read a list of 10 common nouns printed on separate cards in a "flip book" to assess the subject's ability to remember newly learned information. The subject is then asked to recognize the 10 nouns from a list of 20 words read aloud. The subject's score corresponded to the number/20 of words correctly identified. The scores obtained by the subject in this first administration of the tests were used as baseline scores to be compared with later results. Both tests were then repeated to demonstrate that practice has no effect on the subjects' scores. The second test administration was completed immediately after the first because the practice effect, if any, would have been greatest at that time.

The subject then received either a cognitive or physical intervention for a duration of approximately 20 minutes. The cognitive exercise in which the subjects participated was the lottery-type game, Bingo; the 20-minute period of stimulation allowed for an average of 100 numbers to be played. The physical intervention was walking, for the more physically able patients, or arm and leg extensions for the less physically able subjects. Following the 20-minute stimulation period, the Boston Naming Test and the Word List Recognition Task were readministered a final time to observe any alterations in the subjects' scores. After completing these tasks, the individuals resumed group activity or left their day care program, and the subjects' scores from before and after cognitive or physical activity were evaluated. Each patient returned to the day care center within four to seven days and was evaluated again following the same procedures using the alternate intervention. After the final administration of the Boston Naming Test and the Word List Recognition Task on the second day of evaluation, the patient completed the MMSE.

The collected results were analyzed statistically to determine the significance of any alterations in score on the Boston Naming Test and the Word List Recognition Task. A paired t-test and a Wilcoxon signed rank test were used to evaluate the differences in the mean scores on the two tests before and after the cognitive or physical intervention. A t-test was also used to determine whether there was a practice effect that produced any significant changes in score on the Boston Naming Test or the Word List Recognition Task. A Pearson Correlation Analysis was

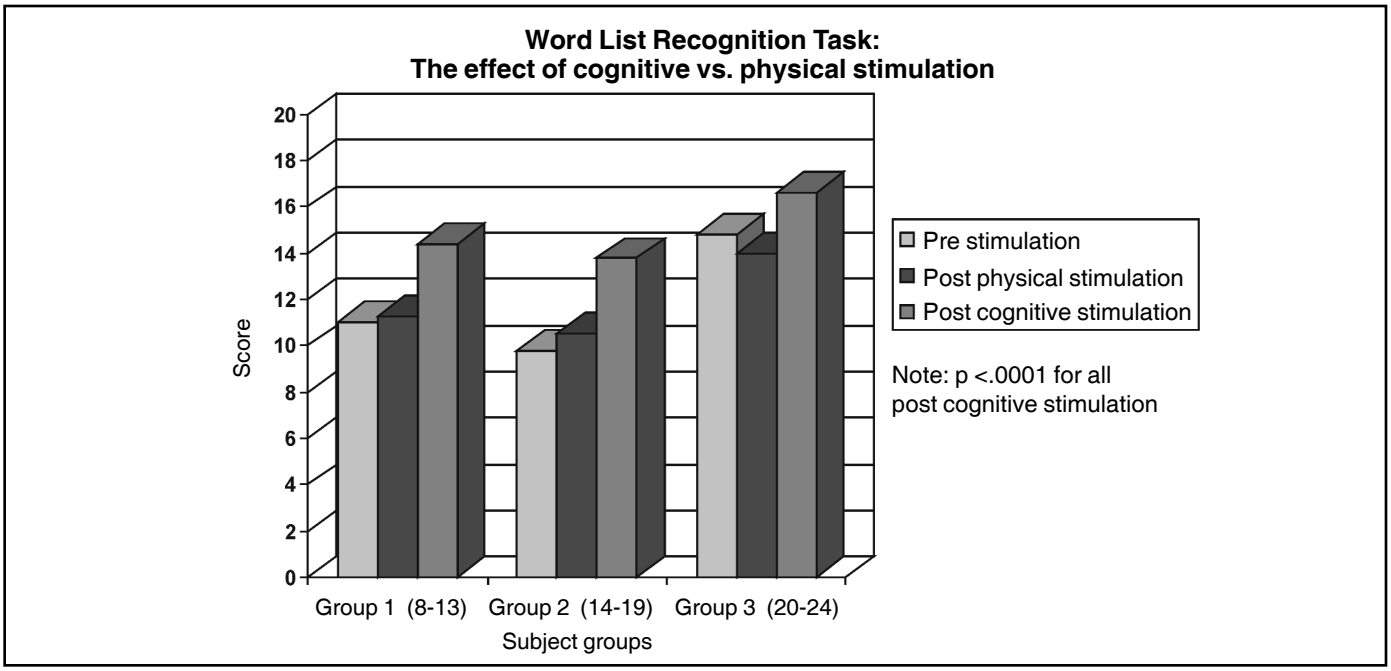

Figure 2. Comparison of scores prior to and following cognitive or physical intervention. (Maximum possible score 20. Subjects grouped by MMSE scores.)

used to test for a relationship between Mini-Mental Status score and change in score on the Boston Naming Test or the Word List Recognition Task after either cognitive or physical intervention.

Results

The mean age of the subjects tested was 82, with a range of 62 to 99. Of the patients tested, 28 were female and 22 were male. The mean score on the Mini-Mental Status Examination was 14.08, ranging from 8 to 25. For closer analysis, the subjects were divided into three groups after being tested: group 1 had MMSE scores between 8 and 13; group 2, between 14 and 19; and group 3, between 20 and 24.

Prior to either cognitive or physical stimulation, the subjects in group 1 earned mean scores of 7.8 on the Boston Naming Test and 11 on the Word List Recognition Task. After the 20-minute cognitive intervention, their scores increased on the Boston Naming Test by an average of 3.12 points ($p < .0001$) (Figure 1) and the mean increase on the Word List Recognition Task was 3.42 points ($p < .0001$) (Figure 2). These improvements correspond to a 46.06 percent increase in total score on the Boston Naming Test (Figure 3) and a 41.18 percent improvement on the Word List Recognition Task (Figure 4). Following physical activity, their scores on the Boston Naming Test and the Word List Recognition Task showed mean increases of 0.62 ($p = .0909$) and 0.3 points ($p = .3116$), respectively. These changes in score indicate a 5.01 percent improvement in total score on the Boston Naming Test and an 8.54 percent increase on the Word List Recognition Task.

The subjects in group 2 scored a mean of 10.68 on the Boston Naming Test before receiving either form of stimulation and an average of 9.78 on the Word List Recognition Task. After participating in the Bingo activity, their scores increased by 2.63 ($p < .0001$) on the Boston Naming Test and 4.0 points ($p < .0001$) on the Word List Recognition Task. These improvements represent a 33.9 percent increase on the Boston Naming Test and an 88.57 percent elevation in total score on the Word List Recognition Task. After the 20-minute period of walking or exercise, the subjects' scores showed no increase on the Boston Naming Test and improved by only 0.73 points ($p = .1315$) on the Word List Recognition Task. These changes indicate that after physical intervention, their scores rose by only 13.42 percent on the Word List Recognition Task.

The subjects in group 3 earned mean scores of 12.5 on the Boston Naming Test and 14.8 on the Word List Recognition Task prior to cognitive stimulation or physical activity. These subjects showed improvement on the Boston Naming Test and the Word List Recognition Task after cognitive stimulation by a mean increase of 1.67 points ($p < .0001$) and 1.8 points ($p < .0001$), respectively. These elevations in score indicate that there was an 18.47 percent improvement on the Boston Naming Test and a 13.62 percent increase on the Word List Recognition Task following the Bingo activity. Following physical exercise, the subjects' scores on the Boston Naming Test decreased by 0.5 points and dropped by

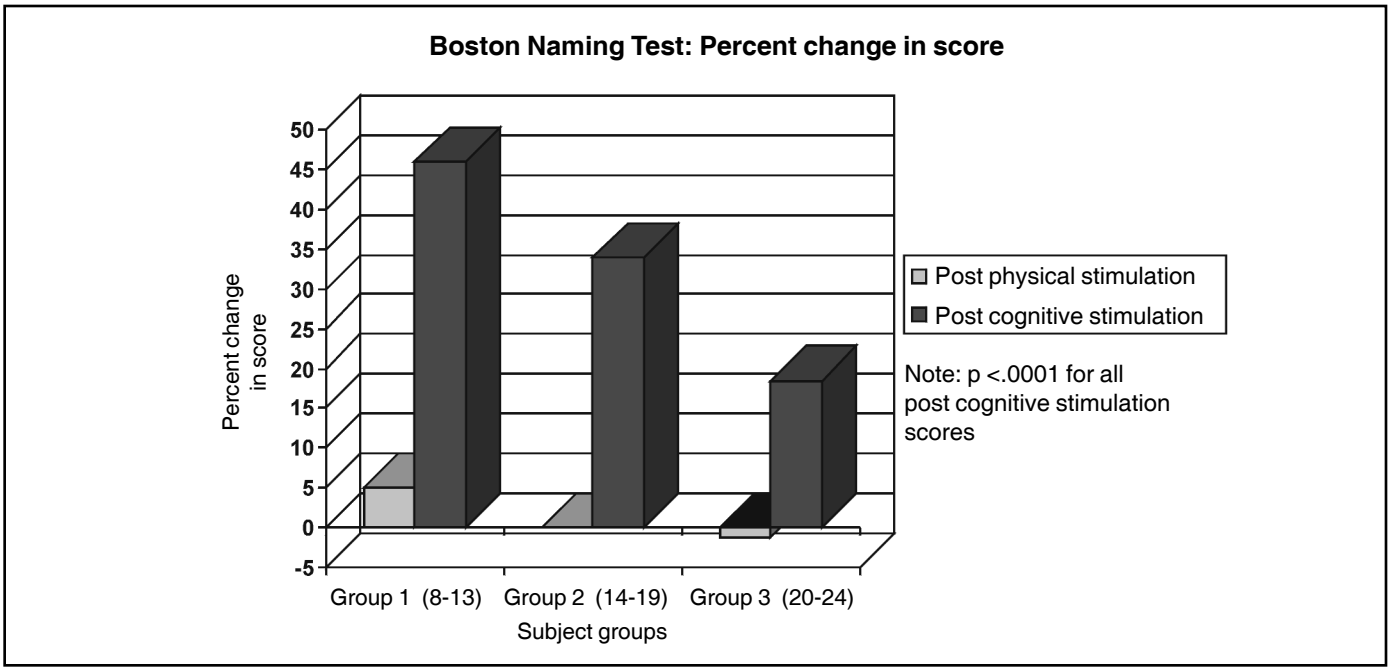

Figure 3. Comparison of percentage changes in total scores on the Boston Naming Test after receiving cognitive stimulation and following physical intervention.

0.8 on the Word List Recognition Task. These changes correspond to a 1.27 percent decrease and a 5.26 percent drop in total score on the two tests.

Of the 50 subjects that were studied, scores of the first 21 were examined to investigate the possibility of a practice effect on either the Boston Naming Test or the Word List Recognition Task. On the first administration of the Boston Naming Test, the mean score earned was 9.52. There was no change in score on the second trial, indicating that there was zero practice effect (Figure 5). On the Word List Recognition Task, the mean score on the first trial was 11.79. On the second administration of this test, scores rose an average of 0.05 points to 11.84 (Figure 5). This increase, however, was not determined to be significant ($p = .7404$).

Discussion

The data from this investigation suggest that physical stimulation is not useful in enhancing cognitive functioning in Alzheimer's patients. On the other hand, the study indicates that Bingo, as a means of cognitive stimulation, is an intervention that is highly therapeutic.

Bingo is an exercise that requires attention, focus, concentration, and motor response. It stimulates multiple processes within the cognitive apparatus, including visual and auditory perception, the capacity to follow instructions, immediate memory, and numerical and letter recognition, as well as visual-motor coordination. It can be speculated that the stimulation of these pathways initiates a signaling effect upon the neural circuits in the areas of the brain involved in the cognitive functions that were shown to improve on the Boston Naming Test and the Word List Recognition Task.

The neural physiology of the observed improvement was not examined in this study. It is possible that the stimulation of the specific brain functions involved in Bingo, and their respective neural circuits, leads to a similar facilitation of cholinergic neurotransmission in the areas of the brain affected by the disease. Further research with newer technologies, such as functional magnetic resonance imaging, is required to better understand the neural physiology of the improvement observed in this study.

As mentioned in the results, no correlation was found between the subjects' degree of cognitive debilitation and the change in score that they demonstrated after physical activity on the Boston Naming Test or the Word List Recognition Task. Similarly, statistical analysis indicated that there was no relationship between MMSE score and score improvement on the Word List Recognition Task after cognitive stimulation. There was, however, evidence suggesting that improvement on the Boston Naming Test following cognitive stimulation is more likely to occur in subjects with Mini-Mental scores between 9 and 15, than in patients with scores above 15. Since this finding was not consistent among the subjects on both the Boston Naming Test and the Word List Recognition Task, it cannot be concluded definitively that cognitive stimulation is more effective in patients with lower Mini-Mental scores. A possible explanation for the higher frequency of improvement on

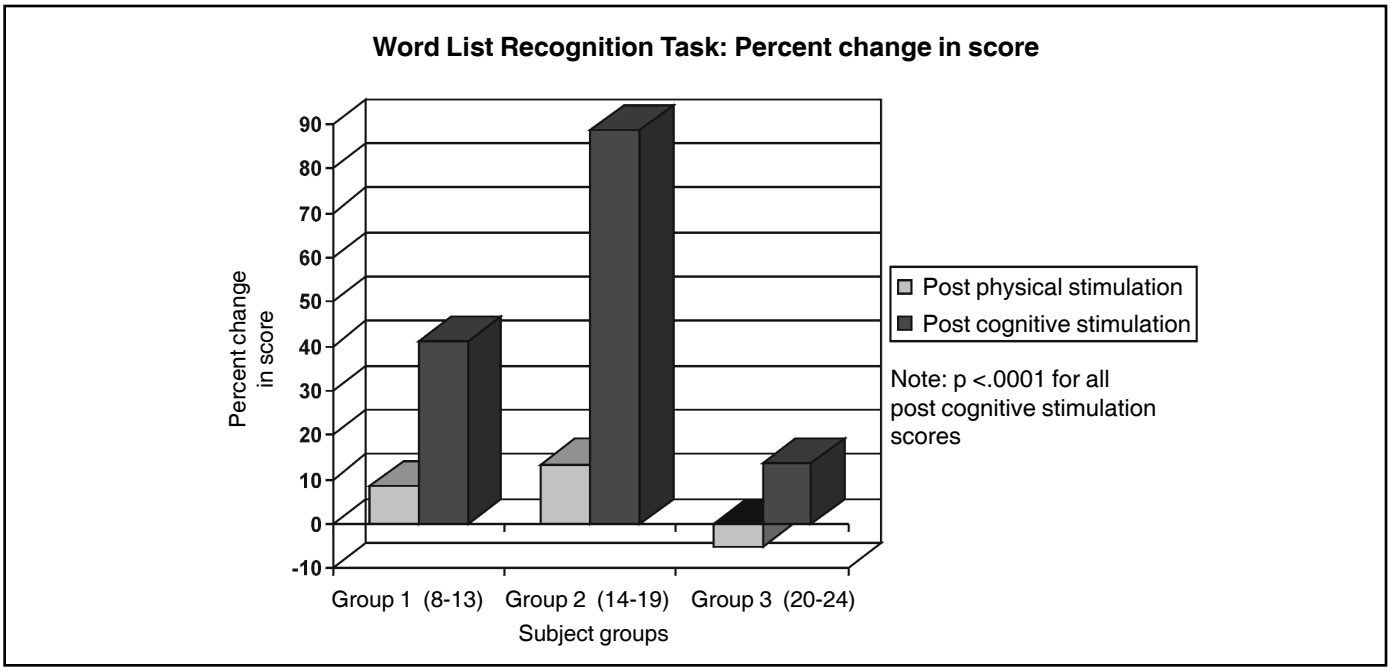

Figure 4. Comparison of percentage changes in total scores on the Word List Recognition Task after receiving cognitive stimulation and following physical intervention.

the Boston Naming Test among subjects with lower Mini-Mental scores may be that they answered more questions incorrectly prior to the cognitive intervention. Subjects with high scores on the MMSE generally earned higher initial scores on the Boston Naming Test. Thus, there was a greater chance that subjects with lower MMSE scores would demonstrate noticeable improvement in scores after playing Bingo. Given that evidence pointing to the efficacy of cognitive stimulation in subjects with lower Mini-Mental scores is inconclusive, and that the score improvements among

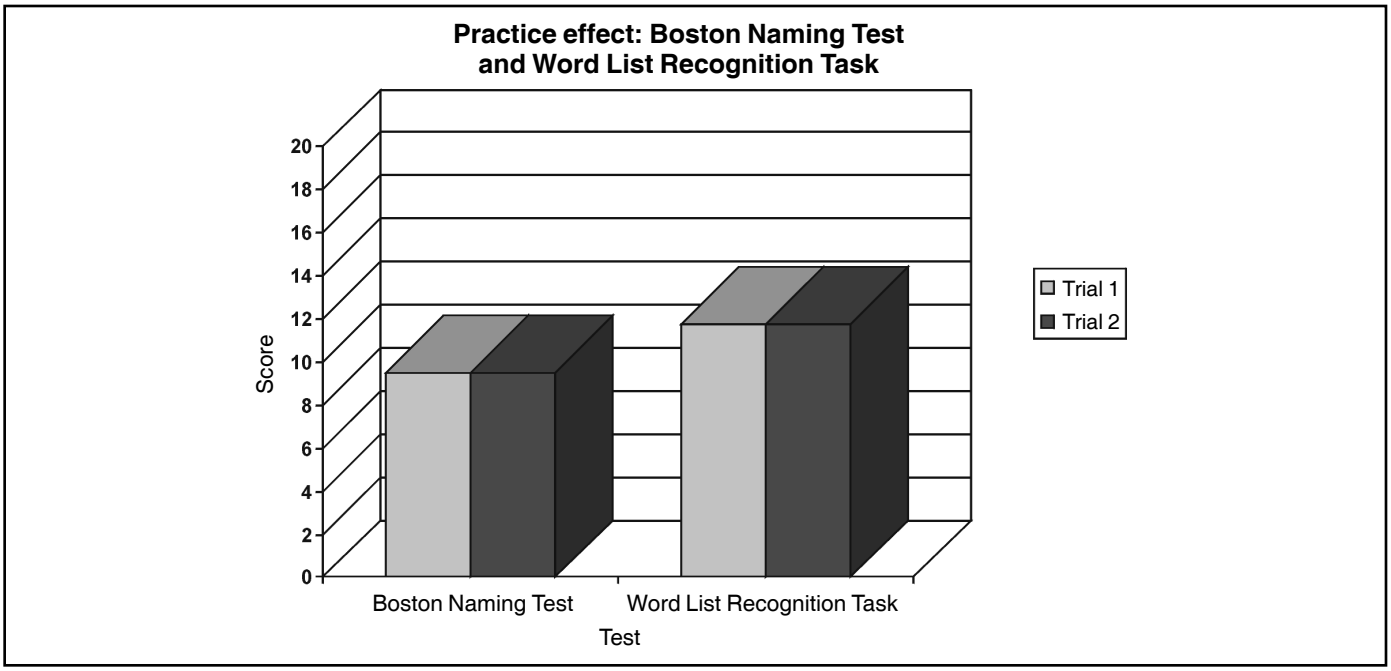

Figure 5. Comparison of first and second administration scores on the Boston Naming Test and the Word List Recognition Task. Both completed prior to receiving either form of intervention.

patients with higher Mini-Mental scores was significant, it can be concluded that cognitive stimulation is effective in patients with MMSE scores ranging from 8 to 24.

This study was a controlled experiment in that all patients tested were equally acquainted with the principal investigator and every subject received the cognitive and physical interventions individually and in identical fashion, assuming that they were not physically disabled. Certain subjects, however, did not receive any physical intervention because their day care program was targeted toward cognitive activities. A limitation of the study was the inability to control the frequency of the subjects' participation in either cognitively or physically stimulating activities. The data did not suggest that subjects at a cognitively-focused day care center responded differently to the interventions due to the nature of their program; however, the question of whether the frequency of cognitive or physical activities can affect a subject's response to either stimulation is a particularly fertile topic for further research.

This study was also unable to determine whether any outside factors contributed to a subject's response, or lack thereof, to the cognitive or physical intervention. These factors could not be kept consistent for all subjects due to the frailty of the geriatric population and the impossibility of controlling the subjects' lives outside of the day care programs. Similar studies in nursing homes, assisted living facilities, and even patients' own homes could investigate the effects of cognitive and physical stimulation under different conditions. Factors such as medications, mood, diet, and sleep could also be tested for effect on subject response to either stimulation.

Other means of cognitive and physical intervention could also be tested for their effects on subjects' performances on the Boston Naming Test, Word List Recognition Task, and other tests that examine a wide variety of cognitive processes. Patients could be evaluated, for example, before and after working on crossword puzzles and word searches, or even after playing a game of cards. Other forms of cognitive stimulation could utilize common recreational items such as Milton Bradley's game Simon.® Studying the effects of a wider array of cognitive interventions could help to understand the specific thought process that is stimulated to produce improvement on cognitive tests. By using multiple forms of intervention in conjunction with Bingo, designed such that each activity stimulates different neurological pathways, it may be possible to isolate the single process, or the several processes, that can be stimulated to enhance cognition in the Alzheimer's population. If this goal can be achieved, both nonpharmacological and pharmacological treatments for the disease may be better targeted, and thus be more effective in stimulating specific neurological functions or a particular area of the brain. It may be possible also to find the interventions that are most appropriate for different levels of Alzheimer's patients. More severely debilitated subjects might be more responsive to a simpler activity, such as Picture Bingo, in which the participant is asked to recognize identical pictures or drawings; conversely, patients in earlier stages of the disease may show greater cognitive improvement after working on a jigsaw puzzle, or another more difficult task.

While there was no observed carry-over effect for either cognitive or physical intervention, a more detailed study of carry-over effect could evaluate more closely whether either stimulation has a lasting effect. Although no change in cognition persisted for the several days between testing, it is possible that the enhancing effects of cognitive stimulation, or those of physical exercise in the subjects who benefited from it, may have lasted. Indeed, staff members and privately hired home attendants reported that they noticed increased awareness and alertness for several hours or the remainder of the day in some of the subjects. However, this time lag was not formally evaluated.

Conclusion

A strength of this study is the simplicity of its design, and its consequent capacity to be implemented on a large scale in Alzheimer's disease care centers and other geriatric settings. The findings of this study warrant further research to gain an understanding of the ability of cognitive stimulation to enhance cognition in Alzheimer's patients on an intermediate and a long-term basis.

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