



STRUCTURED, COMPUTERIZED BRAIN EXERCISE PROGRAM CAN IMPROVE COGNITIVE PERFORMANCE IN OLDER ADULTS

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Abstract

OBJECTIVES: Self-perception of memory loss and decline in memory performance affects approximately 40% of older adults. Previous research indicates an association between engaging in stimulating mental activities and better brain health and memory performance as people age, but results from controlled trials of computerized mental stimulation programs are limited. In the present study, we explore whether a touch screen computer program providing brain training exercises would improve objective memory performance scores in older adults after two and six months of regular use.

DESIGN: Convenience sample of older adults randomized into an intervention using a computer program five days a week for 20-25 minutes each day for a 2-month period, or a wait-list control group. After two months, both groups had access to the computer program and were encouraged to use the program as much or as little as they wished for four months.

SETTING: Local retirement communities in Southern California.

PARTICIPANTS: A sample of older adults without dementia (N=103) were randomized (mean age 83.2, SD=5.6, 67% female); 58

participants completed the 6-month study, including the intervention group (N=32), and the wait-list control group (N=26).

MEASUREMENT: Neuropsychological testing, including objective memory measures (Verbal Pairs, Buschke Selective Reminding Test, and Rey-Osterreith Complex Figure Drawing) and language tests (COWAT-Verbal Fluency and Boston Naming Test) were completed at baseline, two months, and six months; number of sessions played by each participant was recorded at these intervals. Three cognitive domains (Immediate Memory, Delayed Memory and Language) were compared in the two groups as a function of time using mixed models.

RESULTS: The intervention group used the computerized program for an average of 43 (SD = 4.8) sessions during the initial two-month period and an average of 73.5 (SD = 33.6) sessions over the total six-month period; the control group played an average 43 (SD = 34.6) sessions during the final four-months of the study. Mixed models examining the three cognitive domains as a function of time revealed significant group differences in Delayed Memory ($F(2,56) = 5.4, p = .01$) and Language ($F(2,56) = 3.3, p = .05$). The intervention group's composite

score for Delayed Memory and Language was significantly greater at two-months (Time 2) and six-months (Time 3) compared to baseline. The control group's Delayed Memory score was unchanged at Time 2 and there were no significant improvements at Time 3. The control group's Language score, compared to baseline, was significantly greater at six months. For the intervention group, the effect sizes from Time 1 to Time 2 were 0.32 and 0.43 for Delayed Memory and Language, respectively; while the corresponding effect sizes from 2-months to 6-months were 0.63 and 0.65 for Delayed Memory and Language, respectively. By contrast, for the control group, the effect sizes from Time 1 to Time 2 were 0.11 and 0.12 for Delayed Memory and Language, respectively, and 0.10 and 0.16 from Time 2 to Time 3.

CONCLUSION: These results suggest that participating in a computerized brain fitness program for a minimum of 70 sessions over a six-month period improves memory and language abilities. The current results extend an existing body of literature indicating the benefit of cognitive training exercises, whether they are in a classroom format, or delivered via a computerized program.

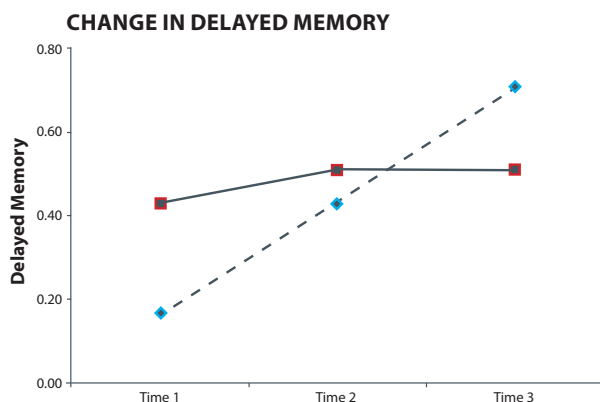


Figure 1: Change in delayed memory Z-scores for intervention and control groups between Time 1-Time 3 (Means and Standard Deviations reported).

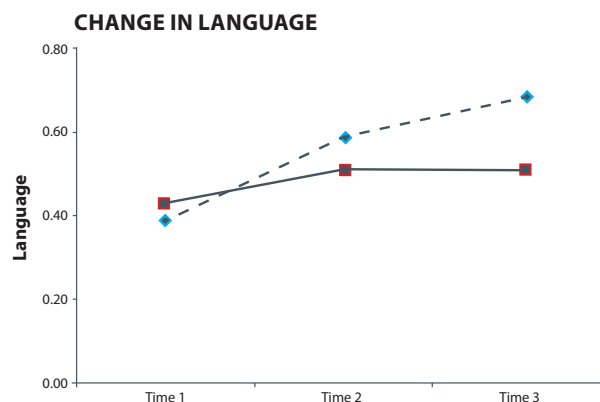


Figure 2: Change in Language Z-scores for intervention and control groups from Time 1 to Time 3.

LEGEND - Figures 1 & 2

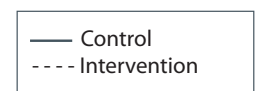


Table 1. Baseline Characteristics of Subjects.

| | Intervention (N=32) | Control (N=26) |
|---|---------------------|----------------|
| Age, mean (SD), y | 83.1 (3.6) | 83.2 (7.5) |
| Education, mean (SD), y | 16.1 (2.2) | 15.7 (2.2) |
| Sex, female, no. (%) | 24 (75) | 15 (58) |
| Ethnicity, Caucasian, no. (%) | 29 (91) | 26 (100) |
| Mini-Mental State Examination, mean (SD) | 28.1 (1.3) | 27.5 (1.8) |
| Montreal Cognitive Assessment, mean (SD) | 24.1 (3.2) | 23.6 (2.9) |
| Weschler Test of Adult Reading, standard score, mean (SD) | 112.5 (8.5) | 111.3 (9.2) |

Table 2. Neuropsychological Test Scores of Subjects

| Domain* / Test | Intervention, Mean (SD) | | | Control, Mean (SD) | | |
|------------------------|-------------------------|-------------|-------------|--------------------|--------------|--------------|
| | Time 1 | Time 2 | Time 3 | Time 1 | Time 2 | Time 3 |
| Delayed Memory† | 0.17 (0.88) | 0.43 (0.75) | 0.71 (0.84) | 0.43 (0.83) | 0.51 (0.74) | 0.51 (0.76) |
| Delayed BFR | 6.4 (3.2) | 6.5 (3.5) | 7.4 (3.2) | 6.6 (2.9) | 6.0 (3.1) | 6.9 (3.5) |
| Delayed Rey Osterrieth | 12.8 (5.3) | 13.5 (5.0) | 14.7 (5.8) | 14.0 (6.5) | 15.0 (6.9) | 13.8 (6.5) |
| Delayed VP | 4.4 (2.6) | 5.7 (2.3) | 6.3 (2.1) | 5.5 (2.4) | 6.2 (2.1) | 5.8 (2.3) |
| Immediate Memory | -0.07 (0.68) | 0.09 (0.71) | 0.23 (0.75) | -0.19 (0.72) | -0.03 (0.73) | -0.08 (0.72) |
| BFR Total | 87.2 (15.6) | 87.6 (14.2) | 89.3 (16.9) | 78.4 (17.4) | 84.1 (17.6) | 85.1 (1.1) |
| Rey-Osterrieth Copy | 29.8 (3.4) | 28.7 (4.4) | 28.6 (4.3) | 27.9 (5.7) | 26.8 (5.4) | 25.9 (6.6) |
| VP Total | 14.2 (7.7) | 18.7 (7.9) | 20.4 (7.6) | 17.0 (7.9) | 19.8 (7.4) | 19.5 (7.4) |
| Language‡ | 0.41 (0.49) | 0.62 (0.50) | 0.72 (0.48) | 0.44 (0.58) | 0.53 (0.77) | 0.54 (0.65) |
| Boston Naming | 54.2 (3.2) | 56.0 (2.7) | 56.5 (2.5) | 55.0 (5.6) | 55.5 (6.0) | 55.9 (5.8) |
| Animal Naming | 18.4 (4.6) | 18.9 (4.9) | 19.4 (5.0) | 18.3 (3.6) | 18.8 (4.7) | 18.3 (4.2) |
| FAS | 37.9 (10.5) | 40.0 (10.3) | 39.9 (10.3) | 40.1 (9.4) | 39.2 (10.3) | 40.5 (12.1) |

* Domain scores are constructed by averaging the z-scores of the tests belonging to that domain

† F(2,56) = 5.4, p = .01; intervention group ES(Time2-Time1) = 0.32; ES(Time3-Time1) = 0.63; control group ES(Time2-Time1) = 0.11; ES(Time3-Time1) = 0.10

‡ F(2,56) = 3.3, p = .05; intervention group ES(Time2-Time1) = 0.43; ES(Time3-Time1) = 0.65; control group ES(Time2-Time1) = 0.12; ES(Time3-Time1) = 0.16

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