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Facilitating change in health-related behaviors and intentions: a randomized controlled trial of a multidimensional memory program for older adults†

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Objectives: Many older adults are concerned about memory changes with age and consequently seek ways to optimize their memory function. Memory programs are known to be variably effective in improving memory knowledge, other aspects of metamemory, and/or objective memory, but little is known about their impact on implementing and sustaining lifestyle and healthcare-seeking intentions and behaviors.
Methods: We evaluated a multidimensional, evidence-based intervention, the Memory and Aging Program, that provides education about memory and memory change, training in the use of practical memory strategies, and support for implementation of healthy lifestyle behavior changes. In a randomized controlled trial, 42 healthy older adults participated in a program ($n = 21$) or a waitlist control ($n = 21$) group.
Results: Relative to the control group, participants in the program implemented more healthy lifestyle behaviors by the end of the program and maintained these changes 1 month later. Similarly, program participants reported a decreased intention to seek unnecessary medical attention for their memory immediately after the program and 1 month later.
Conclusions: Findings support the use of multidimensional memory programs to promote healthy lifestyles and influence healthcare-seeking behaviors. Discussion focuses on implications of these changes for maximizing cognitive health and minimizing impact on healthcare resources.

Keywords: memory intervention; normal aging; program evaluation; randomized controlled trial

Introduction

Memory decline is a normal part of the cognitive aging process. When queried, older adults report various memory changes in their day-to-day lives, such as difficulty remembering names, misplacing household items, and forgetting to do something they intended to do (Ahmed et al., 2008; Knight, McMahon, Green, & Skeaff, 2004; Weaver Cargin, Collie, Masters, & Maruff, 2008). The nature of these subjective reports is consistent with the types of memory showing objective age-related decline. With age, there are particularly prominent changes in delayed episodic recall, associative memory, and prospective memory (reviewed in Hoyer & Verhaeghen, 2006; Old & Naveh-Benjamin, 2008).

Given the presence of these memory changes, it is not surprising that there are many existing programs aimed at helping older adults compensate for memory decline (reviewed in Yassuda & Nunes, 2009). The foci of these programs vary considerably. Most have an emphasis on learning and practicing specific memory aids and strategies, such as using a memory notebook, repetition or imagery strategies, and/or formal mnemonic techniques (reviewed in Gross et al., 2012). Some programs incorporate education about memory function and aging to help participants understand the changes in their own memory and to counteract prominent myths about age-related memory loss, thereby improving self-efficacy (Fairchild & Scogin, 2010; Hohaus, 2007; Troyer, 2001; Villa & Abeles, 2000; West, Bagwell, & Dark-Freudeman, 2008). More recently, some programs, like the one we describe here, have begun to include a focus on lifestyle issues such as exercise, nutrition, and stress management as vehicles for maximizing cognitive health (Fairchild & Scogin, 2010; Hohaus, 2007; Small et al., 2006).

Evaluation research has provided evidence that memory programs can result in a number of positive outcomes. It is clear that older adults can successfully learn new knowledge and skills related to memory and memory strategies (Troyer, 2001; Turner & Pinkston, 1993). Many programs also enhance other aspects of metamemory, including self-reported memory ability, use of memory strategies, and memory self-efficacy (Fairchild & Scogin,

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2010; Hohaus, 2007; West et al., 2008). The extent to which memory interventions produce changes in objective memory ability is less consistent, with some but not all showing objective changes (e.g., Bottiroli, Cavallini, & Vecchi, 2008; Cavallini, Pagnin, & Vecchi, 2002; Fairchild & Scogin, 2010; Gross & Rebok, 2011; Hohaus, 2007; Hoogenhout, de Groot, van der Elst, & Jolles, 2012; O'Hara et al., 2007; West et al., 2008). Notably, change on objective memory tests is not always a goal of memory intervention, as it does not necessarily predict changes in day-to-day memory functioning (reviewed in Green & Bavalier, 2008; McDaniel & Buggs, 2012).

There is accumulating evidence, therefore, of the impact of memory programs on knowledge, other aspects of metamemory and – to a lesser degree – objective memory ability. There are a number of other potential outcomes, however, that would represent meaningful benefits to participants and be realistic for programs that focus on education and behavior change. The purpose of the present study is to explore two such possible outcomes, namely the impact of a memory program on lifestyle behaviors and the intention to seek medical attention for memory concerns.

Regarding lifestyle behaviors, there is growing evidence that factors such as physical exercise, cognitive and social engagement, nutrition, and stress management have a positive impact on memory and other cognitive abilities and can decrease the risk of developing cognitive disorders (e.g., Flöel et al., 2008; Hertzog, Kramer, Wilson, & Lindenberger, 2008; Wahlin, Maitland, Bäckman, & Dixon, 2003). Indeed, interventions that focus solely on increasing exercise (Erickson et al., 2011) or cognitive engagement (Carlson et al., 2008; Stine-Morrow, Parisi, Morrow, & Park, 2008) have been shown to improve memory and other cognitive abilities. Accordingly, an important aspect of memory intervention would be to enhance memory through a healthy lifestyle by increasing specific health-related behaviors. This has been done by educating participants about the positive effects of a healthy lifestyle, helping them set realistic goals, and/or providing opportunities to engage in these behaviors during the program itself (Fairchild & Scogin, 2010; Hohaus, 2007; Small et al., 2006). What is not known, however, is the extent to which participants make and sustain lifestyle behavioral changes outside of the intervention, which is crucial for maximizing the impact of these lifestyle factors.

It is also unknown whether memory programs for healthy older adults impact healthcare-seeking intentions and behaviors. Many older adults are unsure whether to consult a doctor about their memory, because it can be difficult to tell the difference between normal age-related memory changes that are no cause for concern and those that indicate the onset of a more serious cognitive disorder such as Alzheimer's disease. Although healthcare-seeking is often a desired, positive behavior, this is not necessarily the case for the 'worried well' who exhibit normal age-related changes that do not require medical attention. One would expect that a successful memory intervention program that provides education about the nature of age-related memory decline would decrease the likelihood that healthy individuals seek out medical care for their memory, and this is another purpose of the present study.

We have developed, implemented, and evaluated an evidence-based multidimensional memory program at Baycrest Centre (Toronto, Canada) for older adults with age-normal memory changes. Since the inception of the Memory and Aging Program in 1997, over 900 individuals have participated in the program, and health professionals and students have been trained to facilitate the program using leaders' materials available from Baycrest (Troyer & Vandermorris, 2012). The goals of this broad-based program are to provide education about memory and lifestyle factors affecting memory change (with a focus on instilling a sense of control over memory function), to train participants in the use of evidence-based practical memory strategies, and to enable the implementation of healthy lifestyle behavior changes. In a previous study using a matched (nonrandomized) control group design, we found that the program was effective in increasing knowledge of memory and memory strategies, improving self-reported memory satisfaction and ability, and increasing prospective memory, but not other objectively measured memory abilities (Troyer, 2001).

Research goals

The primary goal of the present study was to determine the effect of this well-established multidimensional memory program on the implementation of healthy lifestyle practices and on the intention to seek medical care for memory concerns. Given the focus of the program on education and behavior change, we expected program participants to increase healthy lifestyle behaviors and decrease their intentions to seek medical care relative to participants in a waitlist control condition. Our secondary goal was to place these findings into context by confirming the effectiveness of the program on traditional outcome measures, using a more rigorous (randomized control) design than previously used. Based on earlier research by ourselves and others, we expected program participants to show improvements in memory knowledge and other aspects of metamemory.

Method

Participants

Potential participants were 45 community-dwelling older adults recruited from newspaper advertisements, word of mouth, and a pool of research participants at Baycrest.

Recruitment materials described the study as an evaluation of the Memory and Aging Program that addresses how memory changes with age and how to improve memory. The normal fee for the program ($95) and parking expenses were waived, but no other compensation was provided.

To be included in the research, potential participants were required to be between the ages of 50 and 90 and be able and willing to participate in either the program or the control condition. Exclusion criteria were: (a) the presence of cognitive impairment on the modified version of the Telephone Interview for Cognitive Status (TICS-M; Welsh, Breitner, & Magruder-Habib, 1993); (b) the presence of any medical conditions that affect cognitive ability, such as stroke, acquired brain injury, other neurological disorders or illnesses, or untreated hypertension; (c) significantly elevated symptoms of depression at baseline testing on the 15-item Geriatric Depression Scale (GDS-15; Sheikh & Yesavage, 1986); and (d) failure to complete pretesting or post-testing sessions, or missing more than one of the five program sessions. In total, three participants were excluded from the study (two had elevated mood scores and one did not complete any post-testing), resulting in a final sample of 42 participants ranging in age from 53 to 86 years.

As described subsequently, participants were randomly assigned to either the program or the waitlist control condition. Demographic characteristics and screening scores for the two groups are presented in Table 1. There were no significant differences between groups in age ($t(40) = 0.65$, $P = 0.52$), sex ratio ($\chi^2(1, N = 42) = 0.00$, $P = 1.00$), education ($t(37) = 1.32$, $P = 0.19$), self-reported health on a four-point scale (LaRue, Bank, Jarvik, & Hetland, 1979) ($t(40) = 0.43$, $P = 0.67$), mood ($t(40) = -1.89$, $P = 0.07$), or cognitive screening scores ($t(40) = 1.30$, $P = 0.20$).

Study design

A randomized waitlist control group design was used. After recruitment into the study, participants were randomized to the program or the control condition using a random number generator. Program and testing sessions were conducted in groups of 5 to 10 participants each and were facilitated by one of us (MW or CG). Program groups participated in testing and intervention sessions, whereas control groups participated in testing only. During their participation in the research, control groups were not involved in any memory-related programs or other research projects. At completion of the research, control participants were given the opportunity to participate in the program, although research data were not collected.

Each group participated in three outcome testing sessions. For the program groups, pretesting occurred prior to beginning the first program session, immediate post-testing occurred after completing the final session, and follow-up testing occurred 1 month later. Control groups were tested at the same time as the program groups. All 42 participants completed each of the three testing sessions, with the exception of one control participant, who was unavailable for the follow-up testing session. Thus, analyses of immediate outcomes were based on a sample size of 42, whereas analyses of longer-term follow-up outcomes were based on a sample size of 41. The flow of participants through the research is shown in Figure 1.

Table 1. Demographic characteristics and screening measures.

	Program ($n = 21$)		Control ($n = 21$)		
	M	(SD)	M	(SD)	d
Age	70.3	(8.2)	72.1	(9.8)	0.2
Education	14.0	(2.3)	15.1	(2.9)	0.4
Sex ratio (male:female)	5:16		5:16		
Self-reported health	2.2	(0.8)	2.1	(0.6)	0.1
GDS	2.7	(2.6)	1.4	(1.5)	0.6
TICS-M	36.9	(4.1)	38.4	(3.5)	0.4

Note: d = Cohen's measure of effect size; GDS = Geriatric Depression Scale; TICS-M = Modified Telephone Interview for Cognitive Status.

Program

The Memory and Aging Program consists of five weekly 2-hour sessions, for a total of 10 hours of intervention. The content and implementation of this multidimensional program have been described in detail elsewhere (Troyer, 2001). Briefly, the first 5 hours focused on age-related memory changes and factors affecting memory, such as health, lifestyle, and stress. These sessions were interactive, with the leader providing information, facilitating discussions, and leading exercises and demonstrations. To facilitate participants' implementation of evidence-based healthy lifestyle behaviors (i.e., relaxation, nutrition, physical exercise, and social and cognitive engagement; Flöel et al., 2008; Hertzog et al., 2008; Wahlin et al., 2003), behavioral principles were used. These included analysis of costs and benefits, formation and articulation of intended behavioral changes, generalization, and positive experiences with new behaviors (reviewed in Rothman, Baldwin, & Hertel, 2004). The remaining 5 hours of the program focused on learning and practicing specific evidence-based memory strategies. Through guided exercises and discussions, participants learned to use and incorporate memory strategies and tools, including spaced retrieval (Clare, Wilson, Breen, & Hodges, 1999; Landauer & Bjork, 1978), implementation intentions (Gollwitzer, 1999; Park, Gutchess, Meade, & Stine-Morrow, 2007), semantic processing (Craik & Lockhart, 1972; Preiss, Lukavský, & Steinová, 2010; Troyer, Häfliger,

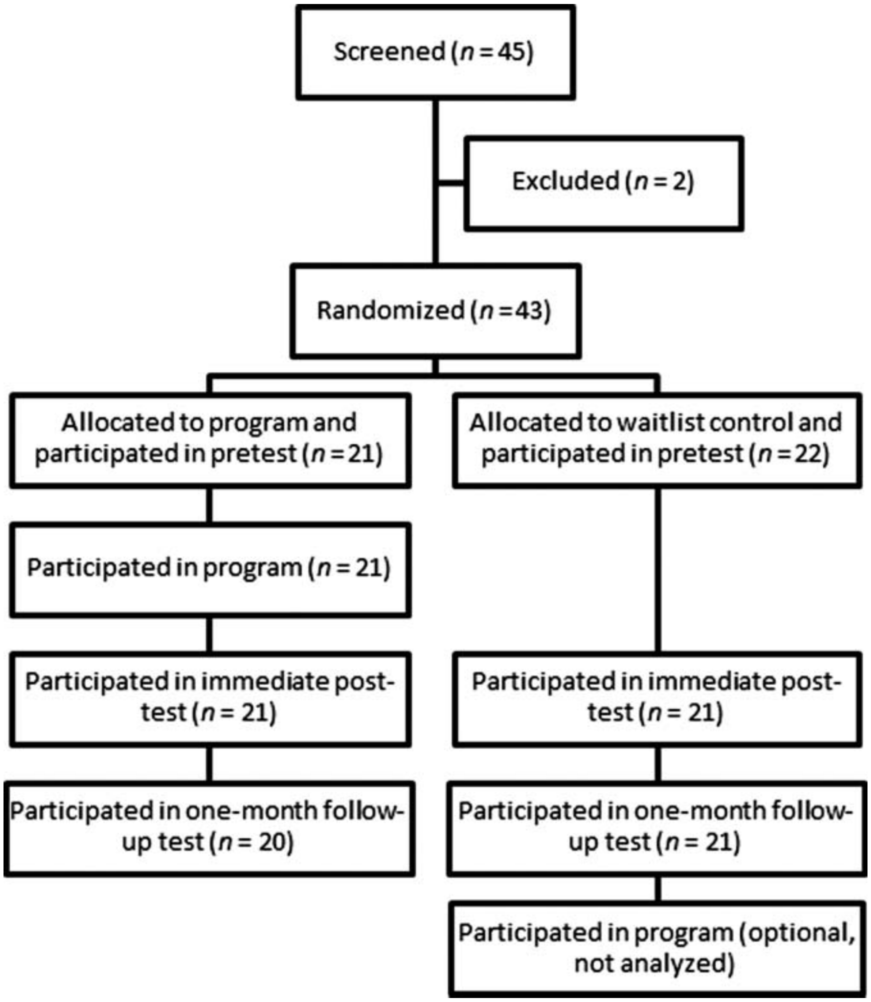

Figure 1. Flow diagram of the progress of participants through the randomized waitlist-controlled trial.

Cadieux, & Craik, 2006), memory books (Johnson, 1997; Patton & Meit, 1993), and memory habits (West, 1995). During the final session, there was an explicit focus on transferring these tools to day-to-day memory situations.

Primary outcome measures

To determine program outcomes, paper-and-pencil tests and questionnaires were administered in a group format during the three testing sessions. To characterize the psychometric properties of each outcome measure, we calculated the test-retest reliability between pretesting and follow-up testing in the control group, and internal consistency of multiple-item measures at pretesting in the combined groups.

Lifestyle changes

Participants were asked to list any lifestyle changes that they had made in the past month to improve their health or memory. Responses were categorized into types of changes (i.e., diet, exercise, relaxation, cognitive engagement, social activities), and an overall score was calculated as the total number of changes listed. The test-retest reliability, calculated as correspondence between scores at the two time points, was high, 86%, and the classification accuracy was statistically significant ($\chi^2(n = 21) = 10.52, P = 0.001$).

Intention to seek medical care

Modeled after the Intentions to Seek Care Questionnaire (Wagner, Phillips, Radford, & Hornsby, 1995), we asked participants to indicate whether they were considering making an appointment with their doctor specifically to discuss their memory or memory concerns. Participants answered using a five-point Likert scale, with higher scores indicating a lower likelihood of seeking medical care. The test-retest reliability was high ($r(19) = 0.75, P < 0.001$.

Secondary outcome measures

Memory knowledge quiz

A 13-item fill-in-the-blank quiz, adapted from a previous evaluation (Troyer, 2001), was created based on the current content of the program to test participants' knowledge of memory processes, types of memory, age-related memory changes, factors that affect memory, and memory strategies. The test-retest reliability, $r(19) = 0.84$, and the internal consistency, $\alpha = 0.69$, were adequate.

Strategy toolbox

To measure the ability to apply memory strategies to everyday situations, we used a previously developed questionnaire (Troyer, 2001). Participants were asked to list memory strategies that would be useful for each of six memory scenarios (e.g., learning a new name, remembering to attend an appointment). Responses were scored according to the number and quality of strategies generated. The test-retest reliability, $r(19) = 0.74$, and the internal consistency, $\alpha = 0.57$, were adequate.

Name-learning task

Participants were shown a list of 12 surnames one at a time in 5-second intervals. Names were simultaneously presented visually by a projector onto a wall screen and orally by the facilitator. Immediately after all names were presented, participants were asked to write down as many names as they could remember, in any order. The test-retest reliability, $r(19) = 0.84$, was high.

Fact-learning task

Participants were shown 12 pieces of information about a fictitious person, such as name, age, address, and hobbies. The information was presented by a projector onto a screen and read aloud by the facilitator, for a total exposure duration of approximately 60 seconds. After presentation, participants were asked to write down as much of the information as they could remember, in any order. The test-retest reliability, $r(19) = 0.59$ was adequate.

Multifactorial Memory Questionnaire (MMQ; Troyer & Rich, 2002)

The MMQ, a 57-item self-report metamemory questionnaire, examines satisfaction with memory functioning, self-rated everyday memory ability, and use of memory strategies. Three separate subscores of 18 to 20 items each were obtained, with higher scores indicating more favorable responses. Test-retest reliabilities, $r(19) = 0.78$ to 0.92, and internal consistencies, $\alpha = 0.87$ to 0.94, were high, consistent with previous findings (Troyer & Rich, 2002).

Memory Controllability Inventory (Lachman, Bandura, Weaver, & Elliott, 1995)

The Memory Controllability Inventory, a 12-item questionnaire, was used to assess perceived control over memory abilities, with higher scores indicating better perceived control. The test-retest reliability, $r(21) = 0.83$, and the internal consistency, $\alpha = .85$, were high, and were slightly stronger than previously reported (Lachman et al., 1995).

Statistical analyses

For each of the two primary measures of interest, data were analyzed with two separate repeated-measures analyses of variance (ANOVAs) corresponding to the outcome intervals (i.e., pretesting to immediate post-testing and pretesting to 1-month follow-up testing). Each ANOVA included one between-groups variable (Group: program vs. control) and one within-groups variable (Time: pretesting vs. post-testing or pretesting vs. follow-up testing). We were most interested in the interaction between group and time. The number needed to treat was also calculated as a measure of clinical efficacy (Cook & Sackett, 1995).

Sets of the remaining outcome measures were analyzed using separate repeated-measures multivariate analyses of variance (MANOVAs). Each overall MANOVA included one between-groups variable (Group), one within-groups variable (Time), and two to four individual outcome measures. For each overall MANOVA with a significant group-by-time interaction, we examined the individual outcome measures using repeated-measures ANOVAs with the same 2 (Group) $\times$ 2 (Time) design.

All statistical analyses were conducted using raw scores. To simplify visual presentation, change scores were used to convey the data in the figures. *Z* scores at pretest, post-test, and follow-up test were calculated using means and standard deviations from the entire group at pretest. Individual change scores were then calculated by subtracting pretest scores from post-test or follow-up scores.

Results

Raw data for the outcome measures at pretest, post-test, and follow-up for each of the participant groups are presented in Table 2.

Baseline comparisons

We conducted preliminary analyses to determine whether there were baseline differences between program and control participants on the outcome measures. A MANOVA

Table 2. Outcome data.

	Program			Control		
	Pretest ($n = 21$)	Post-test ($n = 21$)	Follow-up ($n = 20$)	Pretest ($n = 21$)	Post-test ($n = 21$)	Follow-up ($n = 21$)
Lifestyle changes	0.33 (0.66)	1.10 (0.94)	1.70 (1.66)	0.48 (0.75)	0.48 (0.93)	0.62 (0.86)
Intention to seek medical care	2.71 (1.27)	3.05 (1.24)	3.25 (0.97)	3.29 (0.64)	3.33 (0.58)	3.38 (0.59)
Memory knowledge	6.29 (3.41)	14.21 (6.93)	15.25 (7.45)	7.86 (4.50)	8.00 (3.45)	8.57 (3.80)
Strategy toolbox	10.95 (3.04)	18.24 (7.01)	17.60 (7.03)	13.14 (3.77)	12.91 (3.16)	14.86 (4.10)
Name learning	4.38 (2.03)	4.40 (1.73)	5.50 (1.91)	4.79 (2.42)	4.42 (1.96)	5.74 (2.26)
Fact learning	7.26 (2.65)	7.45 (2.89)	8.60 (2.49)	7.45 (1.92)	8.45 (2.55)	8.69 (2.49)
MMQ-Contentment	41.05 (16.24)	45.52 (13.75)	44.25 (16.44)	46.35 (11.35)	45.47 (12.64)	48.16 (10.65)
MMQ-Ability	46.05 (11.51)	48.90 (8.73)	45.86 (9.66)	51.42 (11.39)	51.72 (11.80)	50.72 (9.68)
MMQ-Strategy	36.90 (11.69)	42.33 (11.04)	42.91 (12.62)	38.60 (10.45)	39.78 (11.63)	41.78 (8.85)
Memory controllability	61.90 (10.00)	64.42 (8.68)	64.40 (6.85)	62.81 (11.20)	61.33 (10.00)	63.12 (8.06)

Note: Data are presented as means (standard deviation). MMQ = Multifactorial Metamemory Questionnaire.

using the 10 outcome measures described previously showed that the main effect of group was not significant ($F(10, 31) = 1.05$, $P = 0.431$, $\eta_p^2 = 0.25$) consistent with the random assignment to groups.

Primary outcome measures

Lifestyle changes

Analysis of immediate outcomes on the measure of lifestyle change indicated a significant group-by-time interaction ($F(1, 40) = 6.45$, $P = 0.015$, $\eta_p^2 = 0.14$). As the change scores show in Figure 2, there was greater implementation of healthy lifestyle behaviors in the program groups than in the control groups during the course of the program. Similarly, analysis of longer-term follow-up outcomes indicated a significant group-by-time interaction ($F(1, 39) = 8.19$, $P = 0.007$, $\eta_p^2 = 0.17$), indicating that program participants made even further lifestyle changes within the month after the program ended.

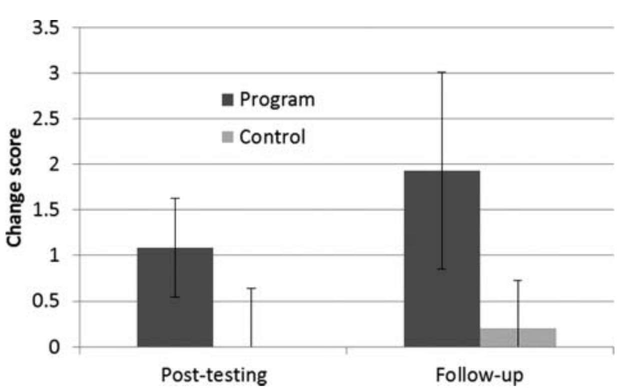

Figure 2. Standardized change scores on the measure of lifestyle behavior change immediately after the program (post-testing) and 1 month later (follow-up testing) obtained by participants in the program and control groups.
Note: A positive change score reflects an increased number of healthy lifestyle behaviors adopted by participants. Error bars represent 95% confidence intervals.

To better understand the nature of the lifestyle changes made, we analyzed qualitative information from this questionnaire. Figure 3 shows the types of lifestyle activities that program participants reported adopting following completion of the program. Immediately after the program, the most common behaviors implemented were

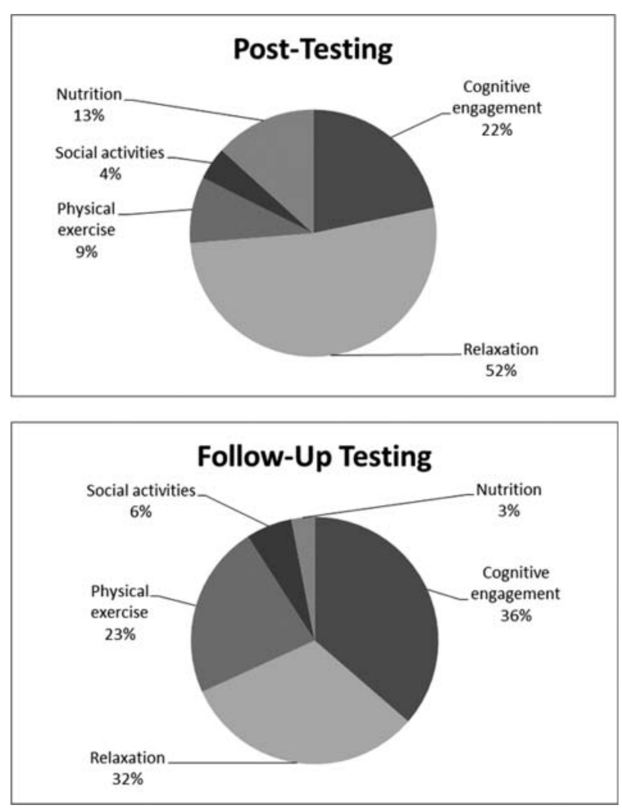

Figure 3. Types and proportions of healthy lifestyle behaviors adopted by program participants at the end of the program (post-testing) and 1 month later (follow-up testing).

relaxation and cognitive engagement, and 1 month later, the most common changes were cognitive engagement, relaxation, and physical exercise.

To provide additional information about the clinical utility of the program, we calculated the number needed to treat (NNT) in order to have one successful outcome in terms of healthy lifestyle behavioral change. For the purpose of this analysis, we defined successful behavioral change as an increase of 1 SD or more from baseline, which translated into adopting one or more new behaviors. Immediately after the program, 14 (67%) of the 21 program participants and five (24%) of the 21 control participants reported at least one behavioral change. Program participants were more likely than control participants to implement a behavioral change (χ^2 (1, n = 42) = 7.79, one-tailed $P = 0.003$), and the NNT was 2.3. One month later, 14 (70%) of the 20 program participants and nine (43%) of the 21 control participants reported a behavioral change. Again, program participants were more likely than control participants to implement a change (χ^2 (1, n = 41) = 3.06, one-tailed $P = 0.04$), and the NNT was 3.7.

Intention to seek medical care

Analysis of immediate outcomes on the measure of intention to seek medical care indicated a small nonsignificant group-by-time interaction ($F(1, 40) = 2.95$, $P = 0.094$, $\eta_p^2 = 0.07$). In contrast, analysis of the longer-term outcome indicated a significant interaction ($F(1, 39) = 6.13$, $P = 0.018$, $\eta_p^2 = 0.14$), indicating that program participants showed significantly decreased intention to seek medical care relative to control participants after 1 month. Change scores for these variables are presented in Figure 4.

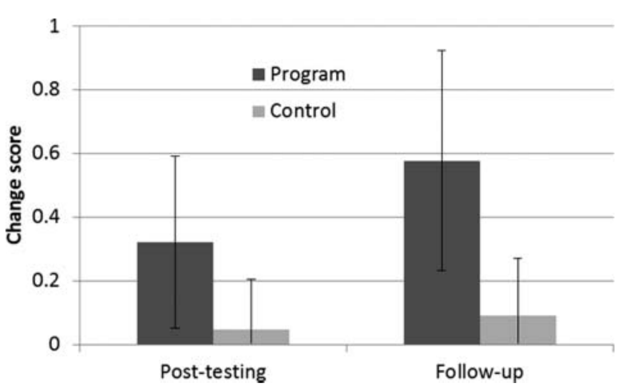

Figure 4. Standardized change scores for intention to seek medical care for memory concerns immediately after the program (post-testing) and 1 month later (follow-up testing) obtained by participants in the program and control groups. Note: A positive change score reflects a decreased intention to seek medical care. Error bars represent 95% confidence intervals.

For NNT analyses, we defined successful change as a decrease of 1 SD or more from baseline, which translates into a one-point change in the self-reported likelihood of seeking medical care over time. Immediately after the program, seven (33%) of the 21 program participants and two (10%) of the 21 control participants reported a decreased intention to seek medical care. Program participants were more likely than control participants to show a decreased intention rating (χ^2 (1, n = 42) = 3.54, one-tailed $P = 0.03$), and the NNT was 4.2. One month later, nine (45%) of the 20 program participants and three (14%) of the 21 control participants decreased their intention to seek medical care. Program participants were more likely to show a decreased intention rating (χ^2 (1, n = 41) = 4.67, one-tailed $P = .015$), and the NNT was 3.3.

Correlates of change on primary outcome measures

The change in lifestyle score (from pretest to follow-up test) showed no sizeable or significant relationships with age ($r(18) = -0.15$, $P = 0.52$) or education ($r(16) = 0.30$, $P = 0.23$), and there were no sex differences in change scores ($t(18) = -0.44$, $P = 0.66$, Cohen's d [measure of effect size] = 0.27). Similarly, the change in intention score was not related to age ($r(18) = 0.37$, $P = 0.11$), education ($r(16) = -0.37$, $P = 0.14$), or sex ($t(18) = 1.10$, $P = 0.29$, $d = 0.49$).

Secondary outcome measures

Measures of knowledge

Overall analysis of immediate knowledge outcomes revealed a significant group-by-time interaction ($F(1, 40) = 47.46$, $P < 0.001$, $\eta_p^2 = 0.54$), as expected. Examination of the individual measures indicated that, relative to control participants, the program group increased their memory knowledge ($F(1, 40) = 32.04$, $P < 0.001$, $\eta_p^2 = 0.45$) and toolbox of memory strategies ($F(1, 40) = 28.48$, $P < 0.001$, $\eta_p^2 = 0.42$) between pre- and post-testing. Analysis of longer-term outcomes indicated that these changes remained significant 1 month later, with significant group-by-time interactions overall ($F(1, 39) = 26.14$, $P < 0.001$, $\eta_p^2 = 0.40$), and for the individual measures of memory knowledge ($F(1, 39) = 32.80$, $P < 0.001$, $\eta_p^2 = 0.46$) and strategy toolbox ($F(1, 39) = 10.24$, $P = 0.003$, $\eta_p^2 = 0.21$).

Objective memory

There were no significant group-by-time interactions for the objective memory tests of name and fact learning immediately after the program, $F(1, 40) < 1$, or 1 month later, $F(1, 39) < 1$.

Other metamemory

These variables included the MMQ subtests (i.e., satisfaction, ability, and strategy) and the Memory Controllability Inventory. Analysis of immediate outcomes indicated a significant overall group-by-time interaction ($F(1, 40) = 7.73$, $P = 0.008$, $\eta_p^2 = 0.16$), reflecting greater improvement in the program group relative to the control group. Exploration of the individual variables showed that program participants had a greater improvement in memory satisfaction than control participants ($F(1, 40) = 6.95$, $P = 0.012$, $\eta_p^2 = 0.15$). Program participants also reported a numerical increase in their strategy use that was small in size but not significant ($F(1, 40) = 3.35$, $P = 0.075$, $\eta_p^2 = 0.08$). There were no significant group-by-time interactions on the measures of self-reported memory ability ($F(1, 40) = 1.68$, $P = 0.203$, $\eta_p^2 = 0.04$) or memory controllability ($F(1, 40) = 1.98$, $P = 0.167$, $\eta_p^2 = 0.05$). Analysis of longer-term outcomes indicated that the overall changes were not present after 1 month ($F(1, 39) = 1.94$, $P = 0.172$, $\eta_p^2 = 0.05$).

Discussion

We obtained evidence that participation in a multidimensional 10-hour memory intervention program impacts lifestyle and healthcare-seeking behaviors and intentions among healthy older adults. This was manifest in two distinct ways, both of which represent novel findings in the literature evaluating memory programs. First, group participants reported implementing new healthy lifestyle behaviors during the course of the program – most frequently relaxation and cognitive engagement activities – and these were maintained 1 month later. Although the multidimensional nature of the intervention precludes an exact determination of the cause of these behavior changes, it is plausible that they are in part due to the program's educational focus. That is, participants learned how lifestyle factors such as stress management and cognitive engagement impact cognitive health and also learned practical ways in which these lifestyle behaviors could be increased in their day-to-day lives. In addition, the reported behavioral changes are also likely due to the use of behavior change principles within the program. That is, participants were encouraged to formulate and articulate their own behavioral change plans based on the educational material presented, and in-class practice of behaviors ensured that participants had successful experiences with those behaviors.

Our second finding was that group participants reported a decreased intention to seek medical attention specifically for their memory immediately after completing the program, and this was maintained 1 month later. Given that all participants were screened for cognitive problems prior to enrolling in the program, this change in intention reflects an accurate self-assessment of one's need for medical assessment or treatment. Although healthcare-seeking is usually a positive behavior, in this case, it represents unnecessary use of healthcare services. In the clinical experiences of ourselves and colleagues, it is not uncommon to see that clients who present to their family doctor with memory complaints are referred to a neurologist or geriatrician for evaluation, and eventually undergo neuropsychological assessment that indicates their cognition is normal for their age. Our current findings indicate that attending a multidimensional memory program may help participants avoid the extra time, cost, effort, and worry associated with a medical work-up of unfounded memory concerns. This decreased intention to seek medical care for memory as a result of participating in the program may have been related to the educational component, specifically, learning about the differences between normal and abnormal age-related cognitive changes, resulting in a more accurate self-assessment of actual memory ability. In addition, training in the use and application of memory strategies may have provided reassurance that the participants have the tools they need to deal with memory decline.

Interestingly, for both our primary measures of interest, scores were numerically higher 1 month after completing the program than they were immediately afterward. This is perhaps not surprising, considering that 5 weeks is a short time frame in which to change behaviors and intentions. It may be that participants require time to reflect on the knowledge and experience gained from the program as well as to experiment with various healthy lifestyle behaviors before they decide on and implement changes.

The changes in lifestyle behaviors and the intention to seek medical attention showed significant differences between program and control groups, but more importantly, also represented clinically meaningful changes. After 1 month, 70% of the program participants adopted at least one additional healthy lifestyle behavior, and 45% of the participants reported a decrease in their intention to seek medical attention for their memory. Taking into consideration that some control individuals also made changes for reasons other than participating in a memory program, the NNTs showed that about three individuals need to take the program in order to get one additional person to benefit from the program that would not have otherwise. This number compares favorably to other interventions aimed at changing health behaviors or intentions. For example, a meta-analysis of interventions aimed at increasing levels of physical exercise has shown an average NNT of 17 (Williams, Hendry, France, Lewis, & Wilkinson, 2007).

Our findings have implications for potential savings to the healthcare system. Adopting healthy behaviors related to stress management, physical exercise, and nutrition can have a positive impact on medical conditions such as hypertension, heart disease, and diabetes. Given the high prevalence of these conditions in the aging population (Kearney et al., 2005; Wild, Roglic, Green, Sicree, & King, 2004), better management could potentially result in improved physical health and decreased need for medical interventions such as medications or visits to healthcare professionals. In a related vein, decreasing unnecessary use of healthcare resources – such as when the worried well seek assessment or treatment for normal memory changes – would have an obvious and direct financial impact on the individuals, insurance companies, and government bodies that fund health care. Because many healthcare systems have limited resources, a decrease in unnecessary visits would also increase the availability of resources for those individuals who do need them. There are, of course, costs associated with running a memory program, most notably, for the facilitator's time and for educational materials. These are, however, minimized by the group setting; in our experience, one healthcare professional can comfortably lead a group of up to 20 participants.

We had a secondary interest in examining traditional outcome measures for memory programs. Similar to our previous research (Troyer, 2001), program participants demonstrated a very large immediate improvement in memory knowledge and application of memory strategies that was maintained over time. We obtained mixed findings on other measures of metamemory. Although program participants reported initial increases in satisfaction with memory, they did not note any changes in actual memory ability or in the use of memory strategies. It is plausible that increased knowledge and satisfaction with memory – specifically, realization and reassurance that participants were experiencing age-normal memory changes – resulted in a decreased perceived need for using memory strategies for their current memory challenges. This would be consistent with our previous research on memory intervention for individuals with documented memory decline related to amnestic mild cognitive impairment; in this population, participation in an intervention program *did* result in increased use of memory strategies (Troyer, Murphy, Anderson, Moscovitch, & Craik, 2008), presumably because participants recognized that strategies were needed in order to compensate for their more extensive memory changes.

We also did not obtain evidence of objective memory changes, consistent with the previously reviewed literature showing variable effects of memory intervention on objective memory measures. As in some other programs, objective memory change was not a primary focus of our intervention, given that objective and subjective memory changes often do not co-occur, possibly because of lack of transfer of some memory changes to everyday memory situations (Green & Bavalier, 2008; see discussion by McDaniel & Bugg, 2012). In addition, there is an inherent mismatch between memory training such as ours that is oriented toward *practical* application of strategies to everyday memory situations outside of the program and the objective memory performance that is measured in the laboratory. As others have noted, there is a need for the development of measures that adequately assess whether participants take the strategies learned during memory training and apply them at home (West, 2012).

Overall, our findings highlight some previously unknown benefits of a multidimensional memory program for healthy older adults, and raise a number of questions for future research. Given that participants report adopting new healthy lifestyle behaviors, it would be interesting to understand the nature of these changes (e.g., the specific aspects of exercise or nutrition that change) and the extent of the changes (e.g., how much additional time is spent in relaxation or cognitive engagement). Similarly, it would be useful to know whether decreased intentions to seek health care for memory translate into fewer actual medical appointments. Given the multidimensional nature of the intervention, it would be informative to know which components produce the specific effects, and whether it is the synergy between components that is key. Finally, given that positive outcomes were not related to age or education in our sample, it would be helpful to know whether the program is beneficial to younger participants who have memory concerns and/or to individuals with low levels of education.

To conclude, there is an increasing need for well-validated memory programs that provide meaningful benefits to older adults, given the aging of our population and the growing demands for services to this age group. Memory programs that emphasize education and lifestyle behavior change may decrease the need for medical care in this group in several ways. They may improve everyday function by providing a toolbox of strategies that older adults can use to compensate for memory decline. As such, these programs have the potential to keep older adults functioning independently in the community for a longer period of time. In addition, as previously reviewed, there is accumulating evidence for an association between healthy lifestyle factors, level of cognitive ability, and risk of dementia. This suggests that multidimensional memory interventions such as ours that result in positive lifestyle changes ultimately have the potential to delay or prevent the onset of severe memory decline in older populations.

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