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Feasibility, Acceptability, and Impact of a self-guided e-learning Memory and Brain Health Promotion Program for Healthy Older Adults

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ABSTRACT

Objectives: To examine the feasibility (e.g., completion rate), acceptability (e.g., satisfaction), and participant-reported impact (e.g., memory concerns, behavior change, goal attainment) of a self-guided, e-learning adaptation of a validated, facilitator-guided, in-person memory intervention for older adults.

Methods: Participants were 139 healthy older adults (mean age: 73 ± 7, 73% women). Participation tracking and pre/post questionnaires embedded within the e-learning program were used to assess feasibility, acceptability, and impact.

Results: Sixty-eight percent of participants completed the program. Anonymous feedback data indicated a high level of satisfaction with the program, the pace and clarity of the learning modules, and the user interface. Suggested improvements included offering more interaction with others and addressing minor platform glitches. There was a 41% decrease in the prevalence of concern about memory changes from baseline to posttest. The majority of participants reported an increase in use of memory strategies and uptake of health-promoting lifestyle behaviors. All participants reported moderate-to-high satisfaction with personal goal attainment.

Conclusions: The program demonstrated good feasibility, acceptability, and lead to reduction in age-related memory concerns.

Clinical Implications: Self-guided, e-learning programming shows promise for fostering positive adaptation to age-related memory changes and improving the uptake of evidence-based strategies to promote brain health among older adults.

Introduction

Concerns about memory changes are common among older adults (Röhr et al., 2020). Memory concerns are associated with heightened distress (Hurt, Burns, & Barrowclough, 2011), reduced quality of life (Stites, Harkins, Rubright, & Karlawish, 2018), and an increased likelihood of seeking unnecessary medical advice (La Joie et al., 2016). Subjective cognitive decline, a classification label applied to persons who express worry about memory decline but score in the normal range on memory testing, is associated with poor health-related quality of life and is a known risk factor

for pathological cognitive outcomes if not adequately addressed (Mitchell, Beaumont, Ferguson, Yadegarfar, & Stubbs, 2014). Routine behaviors such as engaging in health-promoting lifestyle-behaviors and utilizing memory strategies have been shown to mitigate the extent of age-related memory changes (Frankenmolen et al., 2018; Gross et al., 2012; Livingston et al., 2020). Clinician-led interventions that incorporate education and training in the use of these strategies result in a number of positive outcomes. This is particularly true for programs that use a personalized approach with

ecologically relevant tasks that older adults report difficulties with and are motivated to improve (McDougall, 2009). Benefits of these programs include improvements in knowledge about normal age-related memory changes (Kinsella et al., 2016; Troyer, 2001); promotion of lifestyle behaviors that support brain health (Vandermorris, Au, Gardner, & Troyer, 2020; Wiegand, Troyer, Gojmerac, & Murphy, 2013); reduction in subjective cognitive decline (Roheger, Hennersdorf, Riemann, Flöel, & Meinzer, 2021); lower anxiety and stress about memory (Valentijn et al., 2005); and gains in perceived memory ability, memory self-efficacy, strategy use, memory-related affect, psychological well-being, and quality of life (see Hudes, Rich, Troyer, Yusupov, & Vandermorris, 2019 for review).

Despite the reported benefits, several challenges commonly arise when implementing these programs in real-world settings. Namely, the vast majority of existing programs are carried out in-person. Participation in structured, in-person programming is restrictive for individuals with mobility limitations, lack of access to transportation, scheduling conflicts, and for those who reside in geographical regions with limited access to memory care services (Pike et al., 2018). These limitations have been exacerbated in the context of the coronavirus disease 2019 (COVID-19) pandemic, where physical distancing measures have resulted in the cancellation of in-person programs (Fisk, Livingstone, & Pit, 2020), and increases in reports of safety concerns among older adults regarding participation in group gatherings (Lebrasseur et al., 2021). In light of these restrictions, programming has largely shifted to virtual formats, and many older adults have increased their use of technology to stay connected (AGE-WELL, 2020; Haase, Cosco, Kervin, Riadi, & O'Connell, 2021). Therefore, assessing the implementation of virtual e-learning programs for memory and brain health promotion is a relevant and urgent public health priority during and beyond the COVID-19 pandemic.

Despite the fact that online programs designed to enhance cognitive health have been shown to be safe, feasible, and efficacious among older adults, much of the research to date has focused on online cognitive training platforms designed to directly improve objective cognitive performance

(Kueider, Parisi, Gross, & Rebok, 2012; McDaniel & Bugg, 2012; Pike et al., 2018). Although beneficial, there is little evidence that participation in these interventions produces benefits that generalize to day-to-day memory use (Hampshire, Highfield, Parkin, & Owen, 2012; McDaniel & Bugg, 2012; Rebok, Tzuang, & Parisi, 2020), and subjective memory complaints are not always reflected by objective performance on standardized cognitive tasks (Mol, van Boxtel, Willems, & Jolles, 2006). To improve ecological validity, it has been recommended that programs adopt a personalized approach to target awareness and knowledge of age-related cognitive changes, directly address worry about normal age-related memory changes, and include ecologically relevant training in the use evidence-based strategies for improving day-to-day memory functioning that align with participant goals (Hudes et al., 2019; McDaniel & Bugg, 2012; McDougall, 2009; Rebok, Carlson, & Langbaum, 2007; Roheger et al., 2021). A recent study by Klaming, Robbemond, Lemmens, and Hart de Ruijter (2022) found that, compared to a waitlist control group, older adults who participated in an online memory program that was designed to meet the aforementioned needs displayed improvements in memory satisfaction, use of memory strategies, and quality of life. This study, however, did not assess program feasibility, acceptability, or change in subjective cognitive decline. The availability of a feasible and acceptable program for end users that confers positive impacts on subjective memory function may improve participant uptake and retention, and ultimately prevent burden on the healthcare system and reduce the prevalence of cognitive impairments among the aging population.

Recently, a self-guided e-learning memory intervention was co-developed with a group of older adults to address these needs (Yusupov et al., 2022). The program was based on the Memory and Aging Program®, a well-established and validated in-person brain health promotion program that incorporates group education about normal age-related changes and training in the use of memory- and lifestyle-based strategies to improve memory (Troyer & Vandermorris, 2012). The aims of the current study are threefold: 1) evaluate the feasibility of a self-guided e-learning memory and

brain health promotion program among healthy older adults; 2) assess participant-reported acceptability of the program; and 3) examine the impact of the program on memory satisfaction and confidence, personal goal attainment, self-reported use of memory strategies, and uptake of lifestyle behaviors to promote brain health.

Methods

Participants

The current study was embedded within a larger, multi-arm randomized clinical trial investigating the efficacy of multiple online cognitive training platforms among older adults aged 60 and older (clinicaltrials.gov identifier: NCT03602768). Data were collected between March 2018 and December 2020. Participants were recruited from the institutional study participant database as well as online advertisements. Participants first completed an online screening questionnaire to determine preliminary eligibility, followed by a phone interview to confirm that all eligibility criteria were met. To be eligible, individuals must: (a) have had access to and feel comfortable using a desktop or laptop computer; (b) expressed interest in improving their cognitive function; and (c) endorsed some level of difficulty with at least one of the following common age-related cognitive problems: remembering names, focusing attention, remember where thing were put, making decisions, remembering things to do, and solving problems Exclusion criteria included: (a) cognitive impairment determined by a score of less than 30 on the Modified Telephone Interview for Cognitive Status (mTICS; Brandt, Spencer, & Folstein, 1988; Welsh, Breitner, & Magruder-Habib, 1993); (b) comorbidities with major effects on cognition (e.g., mild cognitive impairment, dementia, history of stroke, other neurological disorder); (c) dependence (yes/no) in any instrumental activity of daily living due to changes in memory or thinking abilities including banking, housekeeping, paying bills, taking medication, cooking, driving/transportation, grocery shopping, or managing appointments; and (d) elevated symptoms of depression as indicated by a score greater than 10 on the 9-item Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001). This study was approved by Baycrest Health Sciences' Research Ethics Board (REB 17–24).

Intervention

The self-guided, e-learning Memory and Aging Program (Troyer & Vandermorris, 2012) is a psychoeducation and memory strategy training program for older adults experiencing normal age-related memory changes. The program provides education about how memory changes with age and how memory and brain health are affected by medical, psychological, and lifestyle factors. Training in practical, evidence-based memory strategies is provided, and behavioral intervention techniques are used to help participants adopt brain-healthy lifestyle practices. The format includes online learning modules, remote homework exercises, an asynchronous discussion board, and a supplementary participant workbook. The content is divided into eight web-based units comprised of 31 components intended to be completed sequentially in a self-paced manner over a period of five to nine weeks (see Supplementary Table 1 for the unit details and program schedule). Each unit is designed to take approximately 1 hour to complete, for a total of 10 hours across all program units accounting for discussion postings and homework. This e-learning program is derived from the validated, in-person Memory and Aging Program (Troyer, 2001; Vandermorris et al., 2020, 2017; Wiegand et al., 2013). It was developed to improve program accessibility, convenience, privacy, and flexibility using the agile development cycle, which incorporated feedback from older adult end users using an iterative process (Yusupov et al., 2022).

Data collection

Once enrolled in the e-learning Memory and Aging Program, participants began by completing two online questionnaires embedded within unit 1 of the program. The first questionnaire assessed background information including demographic information (age, self-reported sex, educational attainment), likelihood of seeing a doctor for memory-related concerns, self-reported health status and

memory, and lifestyle changes made within the previous month. Using previously established criteria (Jessen et al., 2014), participants were considered to have subjective cognitive decline if they endorsed a decline in memory and concern about the decline (i.e., "*Do you feel your memory is becoming worse? If you answered yes, does this concern you?*"). The second questionnaire (Troyer & Vandermorris, 2012) asked participants to select their top three goals for participating in the program from a list of 16 goals pertaining to memory strategy use, education, and memory satisfaction. This list of goals was originally developed based on themes evident in responses to open-ended solicitations of participants' pre-program goals (see Supplementary Figure 3 for a list of the goals).

Within the final unit of the program, participants were directed to complete a goal attainment questionnaire and an anonymous program feedback questionnaire. For confidentiality reasons, this questionnaire did not collect participant IP addresses and was not linked to participants' user accounts. The goal attainment questionnaire required participants to indicate their satisfaction with the goals that were endorsed before beginning the program on a 5-point Likert-type scale from 1 (*very satisfied*) to 5 (*very dissatisfied*). The program feedback questionnaire required participants to rate 12 statements about the program content, delivery, and impact on memory satisfaction on a 5-point Likert-type scale from 1 (*strongly agree*) to 5 (*strongly disagree*). Examples of statements include: "*The modules communicated information in an understandable way*," "*The main web page for the online program was well organized and easy to navigate*," and "*As a result of this program, I am more confident about my memory*." Participants were also asked to indicate (yes/no) whether they had made any lifestyle changes (i.e., relaxation techniques, other stress reduction techniques, diet, physical activity, cognitive engagement, and social engagement) since enrolling in the program and whether they had used the memory strategies taught in the program (i.e., implementation intentions, spaced retrieval, semantic elaboration, habits, and external memory aids). Open-ended questions were also asked regarding the best part of the program and suggested improvements. Finally, subjective cognitive decline was assessed again at posttest using the Jessen et al. (2014) criteria questions.

Outcome measures

Program *feasibility* was assessed through the eligibility rate (i.e., proportion of persons screened for the multi-arm randomized controlled trial who met study eligibility criteria to participate in the study), acceptance rate (i.e., proportion of persons invited who actually logged into the e-learning program), and program completion rate (i.e., completion of all 31 program components or not) collected by the research team via monitoring the completion of each unit component. Age, sex, education, subjective cognitive decline, and likelihood of seeing a doctor for memory-related concerns were examined as predictors of program completion.

Program *acceptability* was evaluated using the following components of the program feedback questionnaire: reported satisfaction with the program content and delivery, overall program satisfaction, likelihood of recommending the program to a friend, best part of the program, and suggested program improvements.

Participant-reported *impact* was assessed through pre-/post-program change in rates of subjective cognitive decline, reported uptake of memory strategies and healthy lifestyle behaviors, reported improvements in memory abilities and confidence in memory, and personal goal attainment.

Analyses

All analyses were conducted using SPSS v23. Predictors of program completion rate were explored with a series of chi-squared analyses with the following variables as predictors: age group based on sample median split, sex, educational attainment (high school or less vs. any post-secondary education), presence or absence of subjective cognitive decline, and likelihood of seeing a doctor for memory concerns (yes or undecided vs. no). A threshold for statistical significance was set at p-values less than .05. All other statistical results are reported using descriptive statistics.

Participants provided open-ended responses regarding the best part of the program and what can be improved about the program. A qualitative content analysis following the three phases of analysis including preparation, organization, and reporting was conducted (Elo & Kyngäs, 2008). In the preparation phase, an inductive approach was selected (i.e., generating categories driven by data) while analyzing responses for manifest content. Two authors (DD and IY) independently completed open coding of the data and generated categories freely within the organization phase (Elo & Kyngäs, 2008). Authors DD and IY engaged in a dialogue to agree upon which categories could be grouped together to form a higher order category and to arrive at a consensus for the classifications (i.e., the abstraction process; Graneheim & Lundman, 2004). A third coauthor (SV) with expertise within this field reviewed the categorizations. In the final reporting phase, categories were supported with excerpts from the data (Elo et al., 2014) and results from the coding sheets were tallied according to the frequency in which participants endorsed such categories.

Results

Feasibility and participant characteristics

A total of 1,320 individuals were screened for parent study eligibility, with 394 deemed eligible for participation, resulting in an eligibility rate of 30%. Of the 926 individuals who were ineligible, 17 were less than 60 years of age, 561 reported medical comorbidities impacting cognitive function, 83 did not have access to a computer, 19 showed cognitive impairment on the mTICS, 114 reported a lack of interest in the study goals or no difficulty with any common age-related cognitive problems, 23 declined to participate or were not available during the study dates, and 337 could not be contacted after completing the online screening form. Some individuals were deemed ineligible based on more than one exclusion criteria.

Of the 394 eligible participants, 192 were randomized into another arm of the larger study investigating the efficacy of a different cognitive training platform. Of the 202 individuals randomized into the current study arm, 156 were invited to create an account on the online platform and begin the e-learning program. The 46 individuals who were not invited were not able to be contacted by the administration team after being randomized into the program. An additional 7 individuals meeting trial eligibility requirements piloted the program in its current form before the initiation of the trial and are included in the current analyses, yielding a total of 163 participants invited to begin the program. One hundred and thirty-nine individuals enrolled in the program after receiving an invitation, for an acceptance rate of 85%. Detailed program completion data were not available for four participants due to technical error and were not included in the subsequent analyses.

The sample was comprised of 73% women, averaging 73 years of age (range = 60–91). The majority (85%) had at least some post-secondary education and 99% rated their general health as good, very good, or excellent. Sixty-four percent of participants met criteria for subjective cognitive decline upon enrollment. Nine percent were considering making an appointment with a doctor for memory-related concerns, 26% were undecided, and 63% were not considering an appointment. Detailed information on participant demographic and health-related characteristics is available in Supplementary Table 2.

Participants completed an average of 26 of the 31 program components (range = 3–31, median = 31), and 68% of participants completed all 31 program components. The average number of days that it took participants to complete the program was 61 (range = less than 1 day to 337 days, median = 53) with 80% of participants completing it within 7 to 100 days. Supplementary Figure 1 presents a line graph of the average completion rate over time among all 31 study components. The completion rate by each program component gradually declined throughout the program, with no one unit or module in particular marking significant participant drop off.

Chi-squared analyses revealed that age was a predictor of program completion rate, such that 80% of those who were less than the sample median age of 72 completed all 31 program components compared to 55% of those 72 years of age or older; $x^2(1) = 10.19$, $p = .001$. Program completion rate did not differ by sex (completion rate of 68% for

women and 69% for men; $x^2(1) = 0.04$, $p = .85$), educational attainment (completion rate of 67% for high school or less and 68% for at least some post-secondary education; $x^2(1) = 0.03$, $p = .87$), subjective cognitive decline at program initiation (completion rate of 66% for those with subjective cognitive decline and 72% completed rate for those without subjective cognitive decline; $x^2(1) = 0.58$, $p = .45$), or likelihood of making a doctor's appointment for memory-related concerns (completion rate of 59% for yes or not decided and 73% for no; $x^2(1) = 2.85$, $p = .09$). Line graphs showing program component completion rate by age, sex, educational attainment, subjective cognitive decline, and likelihood of making a doctor's appointment for memory-related concerns are provided inSupplementary Figure 2 a-e.

## Acceptability

Program feedback data were available for 103 participants, of which 3 were young adult study staff who completed the program for training purposes in the context of orientation and onboarding and whose data could not be removed due to anonymity. Of the 100 study participants who completed the program feedback questionnaire, the average age was 72 ± 7 years, 72% were women, and 85% completed at least some post-secondary education.

As seen in Figure 1, in general, participants were very satisfied with the program content and delivery. Specifically, over 90% of individuals somewhat agreed, agreed, or strongly agreed that they were satisfied with the program overall; that they would recommend the program to a friend; and that they were satisfied with the program navigation, pace, organization, and clarity. Additionally, 77% of individuals somewhat agreed, agreed, or strongly agreed that the program fostered a sense of interaction with other participants, with the highest proportion (43%) of these individuals somewhat agreeing with this sentiment.

A total of 103 participants completed the open-ended questions pertaining to the best part of the program and suggested program improvements. Through the qualitative content analysis, 10 categories were identified pertaining to the best part of the program, and nine categories for suggested improvements to the program. Forty-nine responses for the best part of the program and seven responses for suggested program improvements were coded into more than one category. Table 1 summarizes each category, the number of responses coded to each category, and example quotes for each category.

Briefly, participants most commonly reported that the best part of the program pertained to learning and implementing the use of memory
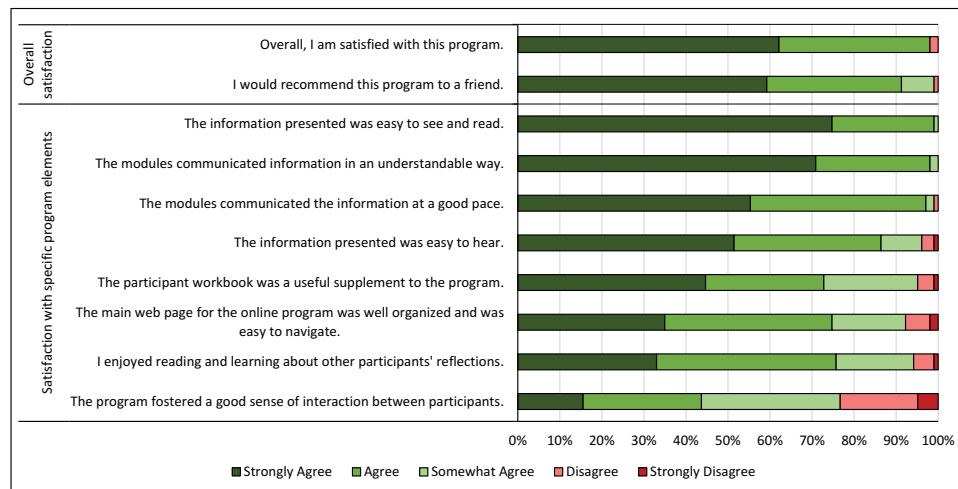
Figure 1. Reported overall satisfaction with the program and satisfaction with specific program elements including content and delivery from the program feedback questionnaire. Data are presented as proportion of participants selecting the degree to which they agree with each statement ($n = 103$).

Table 1. Categories of the open-ended program feedback questions and example quotes.

| Category	Example Quote
What is the best thing about the program?	
Memory strategies (n = 51)	*"I think naming the strategies really brought them to mind for me. Now I consciously use them and name them. This has been very helpful."*
Educational components (n = 34)	*"learning about [how] memory works and what happens with aging. I find it interesting that we remember procedural things like bike riding, skating, etc. yet we can't remember more recent things"*
Engaging and well-organized content (n = 25)	*"The whole on-line course was excellently devised and very user-friendly. The content was right on topic and I enjoyed the posting my experiences, results and comments for other to read."*
Reassurance and sense of normalization (n = 17)	*"One of the best things is realizing that there are many people in the same boat as I am and we don't all have dementia. It was also nice to realize that some of the things I have always done are actually good for avoiding cognitive decline."*
Empowerment (n = 15)	*"The overall benefit of the program is to help me deal with my memory problems. . . . I have done many things on my own to help with it but I now feel that I have an actual program which I can rely on to get me back on track if and when 'I fall off the wagon.'"*
Pace and flexibility (n = 11)	*"Freedom to come and go at will – whenever I had time I could access it."*
Confidence (n = 10)	*"The skills introduced in this program have made me feel more confident that I can remember things more often."*
Opportunity to practice (n = 8)	*"This program allows you time in between each module to practice what you learned."*
Participant workbook (n = 5)	*"The workbook is an excellent resource. It's also very readable for an older adult – large font, well laid out, visually appealing"*
Lifestyle strategies (n = 4)	*"I feel more in control now of my memory. I will be working much harder on diet and exercise, and spending more time on self care and relaxation."*
What about the program could be improved?	
Nothing or don't know (n = 26)	*"I can't think of anything to improve this course. It met my needs and reassured me THANK YOU."*
Navigation (n = 17)	*"The one area I can see being improved was the website, to make navigation a little easier and more intuitive. I am pretty comfortable on a computer, but I know many people my age who are less comfortable and might find it challenging."*
Technological glitches (n = 15)	*"There were some technical difficulties . . . the demonstrations seemed to repeat itself while my response and some suggested responses were being show. A bit distracting."*
More interaction with others (n = 14)	*"I know it was encouraged but people did not seem to communicate with each other on the board. I read others answers to questions but did not comment as I saw no one else was doing so. I think that would make the program richer if there is a way to engage participants with one another."*
Content-related suggestions (n = 7)	*"I found the information fairly basic, but do understand that you have an audience that may not be used to learning. Some references, i.e. suggestions for websites, that would have more detailed and comprehensive information would be useful."*
Length and pace (n = 6)	*"I found it took more time to complete than I anticipated, probably because I had to go back and reread the information several times to help it stick. I'm not sure how to improve this."*
More games and refresher material (n = 6)	*"I would like to see 'refresher' courses available or access to this program for review on an 'as needed' basis similar to taking a book out of the library. I found it very helpful and would appreciate occasional 'refresher' opportunities."*
Audio issues (n = 5)	*"There were some modules where it was difficult to hear the speaker and occasionally, I had to restart the module."*
More feedback (n = 4)	*"Maybe having someone contact from time to time to hear about what you are and are not doing would encourage more consistent use of strategies."*

strategies taught in the program. Other favorable aspects of the program were (in order of frequency): educational components, the engaging content, the well-organized structure, an increased sense of reassurance and normalization about memory concerns, the ability of the program to foster a sense of empowerment and confidence, the pace and flexibility of the program structure, the opportunity to practice the strategies in day-to-day scenarios, the supplemental workbook, and the lifestyle strategies to improve memory. Regarding suggested program improvements, participants most commonly reported that they did not have any program improvements to suggest. Among those that provided suggestions, the most common category pertained to improvements related to the navigation of the program interface and glitches experienced in the system (i.e., problems logging into the program platform). Participants also reported glitches experienced in the system (i.e.,

problems logging into the program platform), a preference for more interaction with others, suggested content recommendations (e.g., suggested addition of information regarding cognitive abilities other than memory), concerns with the length and pace of the program, issues with the program audio, suggestions to include review material and more games, and more interaction with the program facilitators to discuss concerns and program progress.

Participant-reported impact

Prior to beginning the program, participants most frequently endorsed the goal "*Know the current research and best practices in memory and aging*" (*n* = 68), and "*Use strategies to remember dates*" was the least frequently mentioned personal goal (*n* = 5). The rate of goal endorsement is shown in Supplementary Figure 3. Upon completion of the
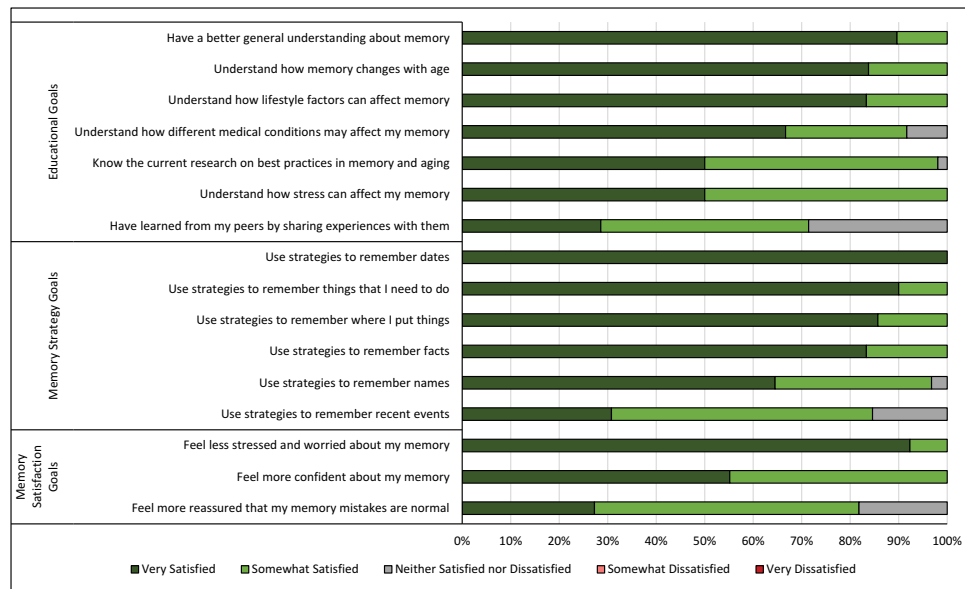
Figure 2. The proportion of participants selecting the degree to which they were satisfied with the goals that they endorsed prior to beginning the program (*n* = 103). See Supplementary Figure 3 for the number of participants who endorsed each goal at baseline.

program, 97 participants completed the goal attainment questionnaire. Satisfaction with meeting the goals that were endorsed prior to beginning the program was relatively high, with no participants reporting that they were very dissatisfied or somewhat dissatisfied with meeting any of their goals. For 10 of the 16 goals, 100% of participants expressed they were either somewhat or very satisfied with goal attainment. Social learning had the lowest proportion of participants reporting that they were satisfied with this goal (71%). The proportion of participants who reported satisfaction with meeting their goals is presented in Figure 2.

Among those who completed the program feedback questionnaire, 64% met criteria for subjective cognitive decline at baseline. Upon completion of the program, this proportion of participants who met the criteria fell to 23%, signifying a notable decrease in subjective cognitive decline before and after completing the e-learning Memory and Aging Program (see Figure 3). All participants reported that they strongly agreed, agreed, or somewhat agreed that their everyday memory function had improved through the use of memory strategies taught in the program. Moreover, 98% of participants strongly agreed, agreed, or somewhat agreed

that they felt more confident about their memory as a result of participating in the program, while two individuals disagreed (see Figure 4). Regarding the uptake of memory strategies as a result of participating in the program, 100% of participants reported using at least one of the five trained memory strategies outside of the program (e.g., implementation intentions, spaced retrieval). Additionally, 94% reported making at least one behavior change to promote brain health (e.g., physical activity, stress management). See Supplementary Figure 4 for the proportion of individuals reporting memory- and lifestyle-based changes across all strategies.

Discussion

The current study investigated participant experience with a novel self-guided, e-learning adaptation of validated memory and brain health promotion program for older adults without diagnosed cognitive impairment. Overall, findings show favorable feasibility and acceptability, and elucidate an opportunity to improve social aspects of the program. There are multiple markers of positive participant-reported impact as a result of program completion, including decreased prevalence of subjective
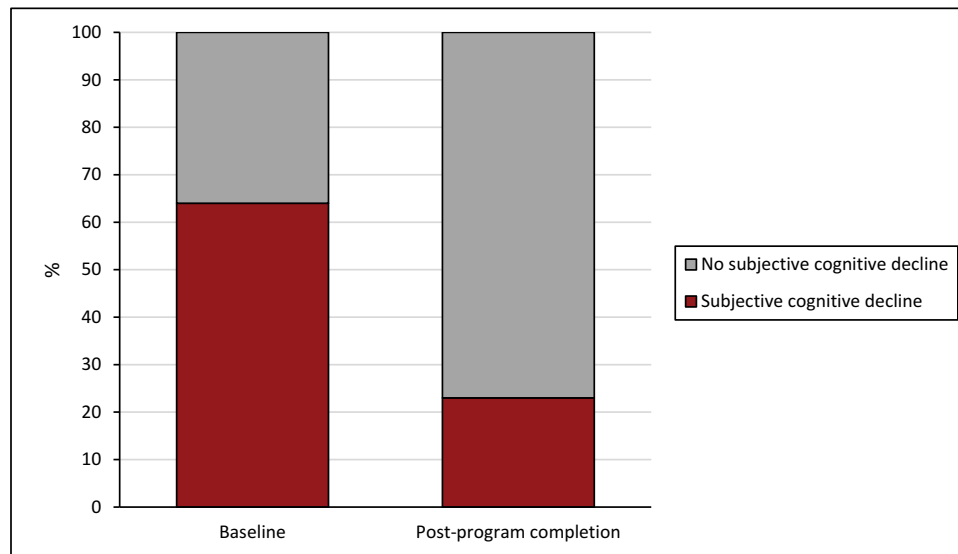
Figure 3. The proportion of participants who met criteria for subjective cognitive decline determined using the Jessen et al. (2014) criteria at baseline (64%) and after completing the program (23%) (*n* = 103).

cognitive decline, improvements in participant-reported memory abilities and confidence, increases in the use of memory-strategies, adoption of health-promoting lifestyle behaviors, and high satisfaction with personal goal attainment.

Program feasibility

We observed relatively high acceptance and completion rates of the program. Although we were unable to find direct comparison data for this specific type of programming, the observed 85% acceptance rate compares favorably with prior studies that have reported 39–66% acceptance rates among older adults for non-memory-related online interventions (Dodge et al., 2014; Green et al., 2011; Poli et al., 2020). Similarly, the observed completion rate of 68% compares favorably to a 50% adherence rate reported in a recent systematic review of online health interventions (Kelders, Kok, Ossebaard, &

Gemert-Pijnen, 2012). Age was the only significant predictor of program completion in the present study, such that participants who were 72 years or older were less likely to complete all program components compared to their younger counterparts. This is consistent with previous research which has found that higher age, but not gender, is associated with lower online program adherence (Poli et al., 2020), and may reflect lower technical literacy among the eldest older adults (Lee et al., 2019). Although the shifting demographic of the aging population may come with enhanced technical literacy among future older adult cohorts, our findings suggest that the program may be better suited for younger older adults with computer knowledge and access. No other demographic or health status variables predicted program completion, though it is noted that our sample represented a relatively urban, well-educated population. Further research into strategies for optimizing accessibility of online
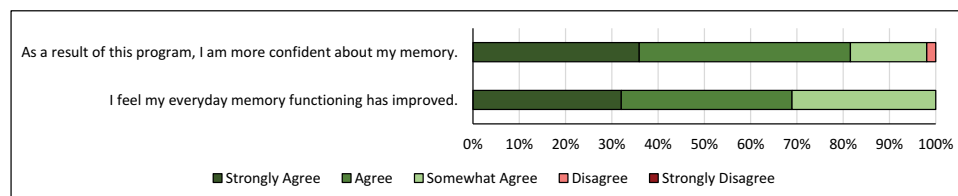
Figure 4. The proportion of individuals reporting improvement in memory confidence and abilities as a result of program completion (*n* = 103).

tools for older adults of diverse sociodemographic backgrounds is key for equitable delivery of brain health promotion programming.

Program acceptability

Both qualitative and quantitative participant feedback indicated acceptability of program by participants (i.e., high satisfaction with the program pace, clarity, content, organization, navigation, as well as experience in the program overall). This was a reasonably foreseen outcome as the e-learning program was developed based on an existing, validated program, with extensive end-user involvement throughout the e-learning design process (Yusupov et al., 2022). However, the availability of feedback data only from persons who completed the program introduces considerable potential for positive bias. Moreover, a main area for improvement identified through participant feedback was the limited opportunity to develop a sense of social interaction between participants. This is an important area for future work as social support and social connectedness are important for initiating behavior change (Rosenstock, Strecher, & Becker, 1988; Webel, Okonsky, Trompeta, & Holzemer, 2010), and social interaction is a known contributor to the benefits of the in-person version of the program (Vandermorris et al., 2017). In the context of the current study, this feedback may be addressed by allowing participants the option to connect virtually face-to-face via video conferencing. Making this optional for participants would preserve the self-guided nature of the program while providing participants the opportunity to connect more personally with fellow participants should they choose. Optimizing social engagement in the e-learning environment and understanding the experience of persons who do not complete online programs are important avenues for future study.

Participant-reported impact

Program impact was assessed using different participant-reported indicators of meta-memory, satisfaction, goal attainment, and behavior change. Perhaps the most striking finding was the 41% post-program decrease in the number of participants reporting subjective cognitive decline. A systematic and meta-analytic review of interventions targeting subjective cognitive decline among older adults found considerable diversity in the nature of such interventions, with evidence for positive impacts on psychological well-being, but not subjective cognitive ability (Bhome, Berry, Huntley, & Howard, 2018). The present program is well-suited to influence perceived cognitive ability, with educational content that may shift expectations about age-related memory changes complimented by practical training that may reduce everyday memory slips. Themes evident within the open-ended feedback reflect this intentionality in design, with appreciation of the education and memory-strategy training, and outcomes of reassurance, normalization, empowerment, and confidence. Indeed, 100% of program completers endorsed at least some level of improvement in everyday memory functioning. Further, there were high rates of endorsement of personal goal attainment, and adaptive behavior changes that may optimize daily memory function and reduce dementia risk (Livingston et al., 2020). These promising findings warrant further investigation, including use of intention-to-treat analyses to account for persons lost to follow-up; investigation of possible mechanisms of change (e.g., age-related memory expectations, reassurance about memory changes, and confidence in memory abilities); and longitudinal study to characterize the duration of effects, long-term dynamics of subjective and objective memory change over time, and the association between program completion and rates of dementia.

In conclusion, given the barriers with accessing face-to-face memory care services, which have been exacerbated by the COVID-19 pandemic, the availability of an accessible, effective, and feasible online brain health promotion program is crucial to promoting health, longevity, and wellness among the growing aging population. Findings suggest that a self-guided, e-learning program for memory and brain health is feasible and acceptable for use by older adults, and has promising capacity for reducing subjective cognitive decline and improving the uptake of evidence-based strategies to promote brain health.

Clinical implications

- Older adults who are anxious or frustrated by normal age-related memory changes are known to benefit from in-person, clinician-led intervention, but accessibility of such interventions is limited.
- The present study demonstrates feasibility of delivering such interventions in a self-guided, e-learning format. There was good uptake in the target population, with participant-reported improvements in key behavioral and memory-related outcomes.
- Self-guided, e-learning programming shows promising capacity for fostering positive adaptation to age-related memory changes and improving the uptake of evidence-based strategies to promote brain health in the older adult population.

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Data availability statement

The quantitative data that support the findings of this study are openly available in the Open Science Framework at https://doi.org/10.17605/OSF.IO/D8PY3. The qualitative data are not publicly available due to their containing information that could compromise the privacy of research participants, but are available from the corresponding author upon reasonable request.

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