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Research Article

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Memory and Cognitive Prevention Training for Typically Aging Seniors in a University Clinic Setting: A Feasibility Study

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Abstract

Purpose: While diagnosis and treatment are the major focus for SLPs, professional roles are expanding to include preventative related services with the elderly. Evidence exists as to the effects of preventative cognitive training (CT), yet few studies have examined viable models for SLP implementation. The purpose of this feasibility study was to compare group and individual CT programs delivered in a university based speech and hearing clinic.

Method: Forty-eight adults, between the ages of 68-92 years-old were assigned to individual or group based conditions in which they received sixteen hours of CT, implemented by an SLP and graduate student clinicians. Cognitive, memory, language, visuospatial and other skills were trained. Formal and informal, pre-post and 12-week follow-up measures were administered. Function and Satisfaction surveys were administered to determine participant perceptions of functional outcomes.

Results: Participants in both CT conditions demonstrated pre-post training gains, although individually trained seniors made more significant improvements than group trained seniors on specific formal measures. The amount of pre to post gain on all assessment measures was similar between groups. Improvements in test scores were maintained at 12-week follow-up testing intervals by both groups. Survey results indicated high satisfaction with CT, although differences were found in perceptual outcomes between groups.

Conclusions: Whereas individual participants yielded more significant effects, the Group condition also represents an effective and efficient model for prevention related services with elderly populations, as demonstrated by pre-post training effects and participant satisfaction responses. Clinical training applications for CT implementation in a university training setting are discussed.

Keywords: Speech Pathology; Memory-cognitive abilities; Prevention Training

Introduction

The implementation of preventative practices with the elderly is not a new concept. In fact, a plethora of research has supported such practices for well over a decade. Given the American Speech-Language-Hearing Association position statement [1], the concept of prevention of communication disorders requires some adjustment to the traditional focus of an SLP's scope of practice. Preventative practice for an SLP entails the elimination of the potential onset of certain types of communication disorders and promotion of the development and maintenance of optimal communication abilities at any given stage of the life cycle. While diagnosis and treatment are a priority for most speech-language pathologists and audiologists, professional roles can be expanded to include an additional focus on prevention. Historically, the SLP profession has focused on prevention for young children whereby support for early intervention services has been upheld by various federal, state and local mandates. To a much lesser extent, has preventative practice been a focus of different pre-service and continuing education activities that are embraced by the SLP profession. According to ASHA's position statement on prevention (1988), alternative professional roles and strategies focused on prevention must be developed, and the information and skills to promote and practice them must be acquired.

The purpose of this feasibility study is to assess the efficacy of a memory-cognitive prevention program tailored after other cognitive training programs for healthy aging adults, and delivered by persons in the SLP discipline in a university speech and hearing clinic setting. It is believed that SLPs are naturally suited and well positioned to implement effective prevention programs for the elderly population. Yet more preservice training efforts are warranted in order to support such discipline wide efforts. The goal of this investigation is to provide evidence for a CT program that will serve as a potentially effective and efficient preventative service model for typically aging adults, that can be implemented by SLP students and professionals in a university based training setting.

The rise of prevention and cognitive training

According to public health sources, global life expectancy has increased by at least six years in the last 2 decades [2]. A challenge associated with a longer lifespan is that most individuals will experience some degree of decline in their cognitive abilities, simply due to typical aging [3]. A plethora of research focusing on various types of prevention training for the typically aging population has sprung up over the last decades. Included in this research are studies focused on memory training, cognitive training, brain training, brain fitness, multi-sensory stimulation, dementia prevention, as well as specific instructional techniques and teaching strategies [4]. The importance of prevention training for the elderly hinges, not only on improving cognitive functioning, but also minimizing loss of function [5]. Invoking the Alzheimer's association projection that if Alzheimer's could be delayed by 5 years; a resulting decrease of 50% would occur in the disease. This should be sufficient motivation for all clinical professionals to become involved in preventative practice.

There have been countless CT studies done over the last decade from which common findings have emerged. First and foremost, the question of efficacy has been investigated. Is CT an effective prevention tool for either improving various cognitive skills and/or forestalling the further deterioration of these skills with aging? In large meta-analyses and systematic reviews of over 30 randomized controlled trials [6-8]. CT and mental stimulation training was compared to active control and no intervention control groups on numerous measures. Significant improvements were reported for CT, when compared to no intervention in 19 out of 26 memory outcomes, and in seven out of 16 executive function measures. When CT groups were compared to active control groups, significant improvements were reported for seven out of 15 memory outcomes, and 17 out of 29 executive function measures. Furthermore, a number of studies reported that specific training effects were maintained for several weeks and months post training, especially when training exceeded ten or more sessions. Transfer of training skills to untrained tasks within the same domain was frequently reported, however transfer of skills to every day functioning was less common [4].

According to different systematic reviews that include studies examining the effectiveness of cognitive interventions for healthy older adults with mild cognitive impairment (MCI), general findings overlap with that of the literature involving healthy adults without MCI [9-11]. Generally these findings suggest that the implementation of CT with aging adults with MCI is effective in improving various aspects of memory performance, executive functioning, processing speed, attention, fluid intelligence and subjects' perception of memory functioning, as measured by formal and task specific measures, as well as particular MRI measures of brain connectivity. In seven out of 26 randomized control trials where follow-up data was provided, positive effects on memory, recall, speed of processing and fluid intelligence were preserved anywhere from one week to two years following training [12-14].

Cognitive prevention training approaches

Most CT teaching strategies can be regarded as either compensatory or restorative in nature [15]. Compensatory tasks are aimed at bypassing various cognitive weaknesses, and capitalizing on other strengths or abilities to achieve a functional goal. These often take the form of external aids or internal strategies (e.g., written lists; memory notebooks, chunking, visual imagery, mnemonic strategies). Compensatory techniques are designed to help a person learn, retrieve, and remember information [9,15]. Restorative methods are focused on strengthening specific cognitive domains, and recovering impaired skills. These include various memory and learning strategies such as errorless learning, errorful learning, spaced retrieval, vanishing cues, and rehearsal, among others. It is difficult to discern the isolated effects of different training strategies because most CT studies have used multiple approaches for training [16].

The specific types of cognitive-memory activities reported in the CT literature are too numerous to list. Most CT programs incorporate different types of memory based training activities that involve different modalities (auditory, visual), aspects of memory (e.g., recognition, immediate recall, episodic memory, delayed recall) and different stimulus materials (e.g., numbers, faces, text, spatial designs, maps, words, computer software). Various cognitive abilities that have been trained include processing speed, attention, reasoning, computation, and various executive functioning abilities and every day activities. The pros and cons of training single versus multiple domain areas in CT programs have been widely discussed [16,17]. Although the use of a multi-modal/sensory approach may facilitate various additive and synergistic training effects, a combination of techniques precludes any type of causal analysis between a specific CT activity and a cognitive change. Based on a number of reports, training multiple cognitive domains, rather than a unimodal domain, has advantages in terms of increased training gains [17], better follow-up maintenance effects and training related increased in brain activity as indicated by neuroimaging studies.

In terms of training dosage, there is too much variation in the CT literature to make valid conclusions about the amount of CT required before improvements can be expected. Training regimens have varied between a few hours, to around 90 hours or more in total, spanning a period of two weeks to up to six months. Training schedules differed from 1-5 days or sessions per week, lasting approximately one to two hours per session. A linear regression analysis was performed by Rejinders et al. [6] to determine if the effectiveness of CT could be predicted by total hours of intervention. There was not a significant effect between hours of training and different CT effects. It was determined by Kelly et al. [4] that transfer and maintenance of CT are most commonly reported when training is adaptive and repetitive, and includes at least ten intervention sessions.

Another factor to consider in the implementation of CT is the efficacy of group versus individual training paradigms. Most CT efficacy studies in the literature have utilized a group based training program. In those limited studies that have incorporated an individual based training format, this has generally served as a condition to which to compare the merits of group training [18-20]. Results have indicated that adults trained in CT groups performed better on 50% of memory measures and had significantly higher self-ratings of memory, and reported more stability and less anxiety about memory functions. Kelly et al. [4] recommends that when possible, those designing CT programs should develop group training contexts that ensure some level of peer support and engagement, which may in turn enhance cognitive performance and growth.

Overall, a number of important trends can be extracted from the prolific volume of intervention and prevention research supporting the use of CT. The most prevalent finding is that when compared to no intervention, various forms of CT are effective in improving memory, cognitive skills and subjective perceptions of cognitive functions in aging adults with intact or mildly impaired cognitive ability. Another trend in the CT literature involves the follow-up effects, or maintenance of learned cognitive skills after training. This maintenance is reported for up to six months, and in some studies beyond that with intermittent booster sessions. According to systematic reviews, a multi-domain focus is more favorably viewed than that of a unimodal focus which includes training only a single type of cognitive skill. Training in a group versus an individualized setting indicated improved memory and subjective cognitive ratings, although very few studies have examined group versus individual CT comparisons.

Prevention programming in university clinics

Few CT regimens for healthy aging adults can be found in Speech Pathology professional or preservice training settings. Karrow et al. [3] reported evidence from a ten-week cognitive wellness program that was implemented with 60-92 year-old individuals with and without MCI. Graduate student clinicians worked with groups of 5-7 senior participants. Training was comprised by cognitive stimulation, counseling, education and homework components. Authors compared participant outcomes in probable MCI (PMCI) versus normal cognitive aging (NCogA) participants. Results indicated all participants made gains on post training formal test measures and that gains were not similar between PMCI and NCogA groups. The use of a control group was not incorporated. As Karrow and Bloom state, SLPS are well equipped to provide cognitive fitness programs for the elderly. Malone and Vaughn [21] supervised a community treatment program that was administered by graduate student clinicians at three different adult residential facilities for 22, 41-89 year old participants. Training provided weekly, one-hour group sessions that included session theme topics and related activities focusing on memory, problem solving, attention, executive functioning, word finding and homework assignments. Positive, yet mixed results were reported across participants. Replication across university programs was recommended, given the valuable exposure for student clinicians. These studies provide preliminary evidence that supervised SLP students can implement effective CT preprogramming for aging adults, and that this type of programming may yield substantial benefits for adult communities and future professionals. Increased evidence is warranted to support the efficiency and efficacy of CT programming for aging seniors in SLP preservice training settings so that more university programs can justify providing this important prevention experience for their students and university communities.

• • • • •The purpose of the present study was to evaluate the feasibility of CT prevention programming for typically aging seniors implemented in an academic clinical training setting. Although recommendations in the literature support a group based CT context, little empirical evidence actually exists. It was believed that the results yielded from a one-to-one cognitive training paradigm would constitute a rigorous standard against which to compare the efficacy of a group CT training regimen. The decision to use an individual CT condition for comparative efficacy was based primarily on the overwhelming finding throughout the literature that when compared to a no-intervention control group, adults participating in CT demonstrate significantly more gains than their no-intervention counterparts. Furthermore, the decision to use an individual versus group CT comparison was influenced by the numbers of seniors that expressed a sole interest in immediate participation in CT programming, and as such, did not wish to participate in a delayed intervention control group. The CT regimens comprised a multi-modal focus on various abilities, including a broad gamut of cognitive, memory, language, executive function, and attentional skills. Of interest was whether these skills would improve as a result of CT, and would potential improvements be maintained over time. Similar to previous research efforts, questions concerning potential predictors of CT success were also explored. Additionally, various pre-post participant perceptions of their cognitive abilities and satisfaction with the CT programming were examined.

Method

Participants

All clinical research activities were approved by the Institutional Review Board at a large, public, Midwestern university. Participants included 48 adults (16 males; 32 females) between the ages of 68 and 92 (M=83.16, SD=6.36), who were recruited through public service announcements and invitation letters distributed to senior residential communities in northeast Iowa, inviting participation in a cognitive-memory prevention program called the Senior MINDS. In this way a convenience sample characterized the population pool in this training study. Recruiting was done over a six-month period during which time participants were tested and assigned to an Individual or Group, Senior MINDS, cognitive training (CT) condition. Four of the participants resided in private homes outside of an adult residential complex, and the others in independent and assisted living quarters associated with two large adult residential communities in northeast Iowa.

Participants were classified as middle or upper middle SES, according to education level and former occupational status [22]. In order to qualify for this project, participants had to be free of any diagnoses of Alzheimer's or dementia, as well as aphasia or other neurological conditions that would directly impair speech intelligibility or writing. Most participants reported concerns with age-related memory deterioration as well as reduced ability to remember names, recognize faces and to respond quickly in various problem solving situations. Before starting the CT sessions, all participants completed a battery of assessments that were administered by graduate student clinicians in the Speech Pathology major at an accredited Midwestern university. Clinicians underwent informational meetings and practice sessions before administering baseline assessments.

Baseline (Pre-training) measures

Baseline assessment measures included a formal standardized test, Cognitive Linguistic Quick Test (CLQT) and a number of informal assessment tasks including Digit Span Memory, Story Comprehension, Time Related Story Math Problems, Face Recognition, Maze Accuracy, and Time Symbol Matching. A detailed description of each of these is included in Appendix A.

A Cognitive Function Aging Survey was also administered. This contained 23 items on which participants rated their perception of the frequency (i.e., always, sometimes, rarely) of occurrence they experienced relative weaknesses in various aspects of cognitive, memory, attention, and language related situations (e.g., difficulty remembering names of family, trouble planning for a busy day). Questions were designed such that a rating of Always indicated a negative perception of one's abilities. Conversely a rating of Never would indicate a positive perception of one's abilities on that particular question. Rating scores for each of the 23 items were compared before and after cognitive training to determine if participants' perceptions of their abilities were impacted as a result of CT. If a participant's rating went from Always to Never or from Always to Sometimes on a particular question, this was considered as an improvement. The reverse pattern of Never to Always, or Never to Sometimes, would indicate a regression on a particular survey question. See Appendix B for the Cognitive Function Survey.

Cognitive training (CT) groups

Participants were assigned to either a Senior MINDS Individual or Group CT condition, after they responded to PSA or recruitment letter. A total of 22 and 26 seniors were assigned to Individual and Group CT conditions respectively. The age range of the participants in the Individual CT group was 73-91 (M=83.77, SD=5.25), including 17 female and 5 male participants. Group CT participants ranged in age from 68-92 (M=82.65, SD=7.24) with 15 female and 11 male participants. Although initial CLQT and informal baseline assessment scores were relatively lower for the Individual participants, a series of independent sample t-tests indicated no significant differences between Individual and Group CLQT, and informal baseline measure scores, with the exception of the time related math problems. Group CT participants scored higher (M=14.42, SD=2.80) than Individual CT participants (M=11.86, SD=5.96).

Cognitive training sessions

A total of 16 hours of CT were provided in both Individual and Group CT conditions. A combination of training techniques was implemented during each CT session which have been supported in various efficacy studies, including errorless learning, spaced retrieval, mental imagery, and chaining procedures Training tasks and materials selection was influenced by various studies incorporating cross modal or multisensory means of stimulation and training to enhance and/or prevent memory, cognitive, and attention deterioration in aging populations [23-27]. During each session, participants completed a number of different activities including, Digit Span memory, spatial and memory, auditory memory and mental manipulation, narrative retention, maze completion, symbol cancellation, symbol trails, reading comprehension and text memory, time-based math problems, confrontation naming and facial recognition tasks, among others. Most activities tapped certain types of memory skills, reasoning abilities, problem solving, processing speed, language comprehension and use, among other cognitive skills. Activities were approximately 5-6 minutes in duration and implemented at a steady pace, as per recommendations in the literature to incorporate a wide variety of activities in a short period of time so as to maximize attention and prevent boredom [26]. A number of 1-2 minute filler activities were interjected into sessions for purposes of maintaining active participation by group members who would finish an activity before others, and individual members who tended to complete activities at a faster pace than allocated. Training materials were either developed by the author or taken and modified from the Workbook of Activities for Language and Cognition (WALC) series, specifically workbooks 5-10 created by Lingui Systems, and the Problem Solving Therapy Program Facial recognition was addressed by systematically introducing a collection of headshot photos with accompanying names over the eight week training period which were all associated with a contrived wedding party that was created by the author [27]. WALC face recognition drawings were also used as a secondary means of addressing facial recognition skills. Specific homework activities were reviewed during the last 5-8 minutes of each Group session and then sent home with each senior after individual and group CT sessions. The exact same sets of activities, and total hours of training were implemented in the group and individual CT settings, with the only differences being the number and length of sessions conducted under each training condition See Appendix D for a list of training activities and the sessions in which they were implemented, as well as sample homework assignments.

Individual training condition: Sixteen one-hour individual CT sessions were provided twice weekly, over an 8-9 week period (making up missed sessions during the ninth week). Sessions were conducted either in a participant's home or a university speech and hearing clinic by graduate student clinicians. Each session began with Digit Span memory tasks, often times focusing on 7-10 digit phone numbers. Other activities ensued which consisted of a series of 5-6 minute memory, cognitive, language and/or executive functioning tasks. These included specific activities tapping into auditory and visual memory, face/name recognition and memory, visual-spatial manipulation skills, math-based problem solving, story memory and comprehension, confrontation naming, narration, and combinations thereof. As the individual CT sessions progressed, up to 15 different activities were completed per session, including fill-in activities which varied by senior. Approximately 2-3 homework assignments were assigned during individual CT sessions, with directions to be completed by the next CT session.

Group training condition: Eight, two-hour group CT sessions were provided over an eight-week period in a university based classroom furnished with oblong tables and chairs and overhead projection system with large television monitors mounted on walls at the four corners of the room. Each group session was conducted by the author, in addition to five graduate student clinicians that were each grouped with 2 or 3 senior participants each. Due to available classroom size, two cohorts of group training were conducted containing 14 and 12 senior participants each. The author presented all visual materials via a classroom projection system, and with aid of FM microphone system. After visual materials and verbal directions for each activity were presented to the group at large, graduate student clinicians provided support to senior participants to facilitate completion of designated activities. Training materials and directions in the Group CT sessions were exactly the same as those used in the Individual CT sessions, adhering to the same presentation sequence, presentation manner and specific training strategies. The only difference was that each group session doubled up on the number of activities implemented such that activities from individual CT sessions 1 and 2 were combined for group session 1; activities from individual CT sessions 3 and 4 were combined for group session 2, and so on.

Post training assessments: After the completion of individual and group CT regimens, senior participants were retested using the same battery of formal and informal measures that were used during pre-training baseline assessments. The Cognitive Function Aging Survey was re-administered. Additionally, the Satisfaction Survey was completed. This survey included 16 questions relating to a participant's perceptions of the quality of the program and its impact on various memory, cognitive and language skills, as well as overall confidence associated with such skills, and satisfaction with the Senior MINDS program. Questions were designed such that a rating of strongly disagree would receive a score of 1 and indicate a negative perception of one's abilities and the program. Conversely a rating of strongly agree would receive a score of 4 and indicate a positive perception of one's abilities and the CT program (Appendix C).

Post-post (PP) training assessments: Participants were tested again 12 to 14 weeks after the completion of CT, using the same battery of measures as that used for pre/post training with the exception of the two self-rating scales.

Treatment fidelity

Detailed scripts outlining individual session activities, administrative guidelines and specific directions were distributed to participating graduate student clinicians, along with session materials and stimulus items which were provided in paper packet forms. Materials were made available to clinicians at least one week prior to each training session so as to provide clinicians the opportunity to record any questions regarding implementation and procedures. Group meetings were conducted once or twice weekly for one-two hours with author and graduate student clinicians. Session packets and implementation were reviewed for each CT session. Homework activities were also reviewed and implementation procedures modeled for the clinicians. Individual participants were discussed and questions addressed concerning potential implementation constraints, problems or other issues that clinicians might foresee. Specific scenarios were outlined for addressing such issues as modulating complexity of materials, trials dispersal, reinforcement schedules, cueing hierarchies, use of compensatory strategies, task directions, off-task behaviors, and other materials and implementation related issues. Specific guidelines and practice for scoring all CT related activities was provided. Two or more individual participant CT sessions were attended by the author in order to ensure that designated CT procedures were implemented by student clinicians and that training scripts were specifically followed. Clinicians were encouraged to discuss any issues concerning an individual client's CT outside of group meetings.

Reliability

Inter-rater reliability probes were conducted for 12 out of 48 (25%) of the study participants. Seven of these were Individual group participants and 5 were Group participants. Reliability was taken on all formal and informal measures at the 3 testing intervals, including performance on the CLQT and the six informal assessment activities. Reliability probes were taken by having two graduate student clinicians present during testing, one administering specific assessments while recording responses, and the other recording participant responses on a separate protocol or test form. Assessment responses were scored independently by each of the students and point by point agreement was calculated by dividing the number of agreements by agreements +disagreements on each CLQT subtest and other pre-post-PP baseline measures. Individual reliability scores were collapsed across participants and mean percentages of agreement computed. Inter-rater agreement on CLQT subtests averaged 97% (Range=86-100%); and 93.6% for CLQT composites scores (Range=81-100%). Agreement for informal measures averaged 95% (Range=75-100%).

Results

Individual versus group CT comparisons

In order to compare the overall progress made by the Individual and Group CT participants, a series of Mixed Model (2 × 3) ANOVAs were conducted with CT Group (Individual versus Group) serving as the between-subject variable, and testing interval (pre/baseline, post, PP) serving as the within-subject variable. The CLQT cognitive domain composites of Attention, Memory, Executive Function, Language, Visuospatial Skills, and Severity Rating, as well as the subtests of Story Retell and Generative Naming were examined. Additionally, informal measures including Digit Span Memory [1-4], maze time, story comprehension, time based math calculations, and face recognition were compared in order to determine group differences at pre, post and post-post measurement intervals. Follow-up pairwise comparisons, at the 0.05 significance (95% confidence) level were made using the Bonferroni method, in order to adjust for multiple pairwise comparisons.

CLQT composite and subtest comparisons: Results of 2 × 3 ANOVAs indicated a significant main effect for testing interval for the CLQT Attention composite, F (2,46)=3.88, p=0.023. Bonferroni pairwise comparisons indicated that CLQT Attention scores for post (M=175.38, SD=39.09) and PP (M=180.03, SD=32.08) testing were significantly higher than baseline (M=162.55, SD=43.70) scores across both CT groups. A significant main effect, F (1,46)=4.79, p=0.031 was found between the Individual (M=146.87, SD=26.44) and Group CT group (M=154.35, SD=20.53) for the CLQT Memory composite, but no testing interval effect revealed. Similarly, a significant main effect for group was obtained for the Executive Function composite F (1,46)=7.13, p=0.009 with the Individual CT group (M=23.78, SD=6.87) scoring lower overall than the Group CT group (M=26.32, SD=6.87). Composite Language scores were significantly different, F (2,45)=3.31, p=040, from pre (M=29.50, SD=3.50) to post testing (M=30.87, SD=3.40). Visual Skill composite scores differed between groups F (1,46)=4.52, p=0.036, indicating lower scores for the Individual CT group (M=76.52, SD=19.90), than the Group CT group (M=82.27, SD=16.43) overall. Story Retell subtest scores revealed a main effect for group F (1,46)=4.07, p=0.046, and testing interval F (2,45)=5.59, p=0.005. Individual CT subjects scored lower overall (M=6.63, SD=2.11) than Group CT subjects (M=7.19, SD=1.76), and scores were lower for baseline (M=6.33, SD=2.09) than for post testing (M=7.10, SD=1.72). No significant interactions were revealed throughout CLQT Group × Testing Interval ANOVAs.

Informal measure comparisons: Digit Span memory was measured four different ways, each reflecting significant main effects for testing interval. No significant main effects for CT group were uncovered for any of the measures of Digit Span memory. However a significant main effect for testing interval was revealed for each Digit Span measure. For DS1, F (2,45)=10.12, p<0.000; baseline scores (M=66.14, SD=18.31) were lower than post (M=74.48, SD=14.84) and PP scores (M=74.77, SD 14.05). For DS2, F (2,45)=12.37, p<0.000; baseline (M=74.42, SD=16.50) scores were lower than post (M=82.23, SD=11.78) and PP (M=82.33, SD=11.74) scores. For DS3, F (2,45)=6.71, p=0.002, baseline scores (M=55.75, SD=18.26) were lower than post scores (M=62.58, SD=17.65) and PP scores (M=63.21, SD=18.21). For DS4, F (2,45)=3.58, p=0.031, baseline scores (M=2.19, SD=2.66) were lower than PP scores (M=4.02, SD=2.75). Maze time (in seconds) reflected a significant main effect for testing period, F (2,45)=5.82, p=0.004, with higher baseline (M=45.79, SD=32.69) than post training times (M=35.00, SD=24.95). Significant group and testing interval main effects were obtained for the informal story comprehension analyses. Group CT participants performed better overall (M=10.29, SD=4.51) than individual CT participants (M=8.48, SD=4.30) for story comprehension questions. Pre training scores were lower (M=8.25, SD=3.52) than PP scores (M=10.47, SD =5.22). A main effect for group was obtained for time-related math story problems F (1,46)=26.01, p<0.000, with the group performing better overall (M=14.92, SD=2.60) than individual participants (M=12.53, SD=5.43). Facial recognition analyses revealed a significant testing interval main effect F (2,45)=4.06, p=0.020. Participant PP scores (M=19.14, SD=6.72) were significantly better than pre training scores (M=15.87, SD=6.09). No interactions were revealed across informal measure ANOVAs.

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Within-group pre-post-PP outcomes

Each CT groups was analyzed separately in order to gain a more in-depth picture of specific CT group performance patterns from pre to post to PP testing intervals. A series of within-subjects ANOVAs were performed on CLQT composites, and Generative Naming and Story Retell subtest scores, as well as informal measure scores at pre, post and PP testing intervals. The Bonferroni method was used for post hoc comparisons. In this way, it was determined if significant performance differences existed from pre to post, pre to PP, or post to PP testing intervals, for each CT group. Cohen D effect sizes were computed for each of the significant post hoc comparisons. See Table 1 for a list of means, standard deviations and ranges for Individual and Group CLQT and informal pre, post and PP measures. See Table 2 for a list of Cohen d effect sizes for significant pairwise comparisons.

		Individual			Group		
Measure CLQT		Pre	Post	Post-Post	Pre	Post	Post-Post
Att	Mean (SD)	157.41 (42.23)	172.80 (40.35)	175.81 (40.00)	165.35 (44.68)	177.19 (38.68)	184.73 (22.89)
	Range	17-201	12-204	14-204	37-206	53-217	123-207
Mem	Mean (SD)	144.23 (28.81)	151.50 (23.25)	148.38 (27.92)	150.15 (23.02)	154.31 (18.09)	158.62 (20.08)
	Range	52-172	64-172	44-181	77-150	116-196	96-183
ExF	Mean (SD)	22.82 (7.01)	24.55 (6.67)	24.24 (7.22)	26.08 (5.37)	26.88 (5.94)	26.00 (5.43)
	Range	11749	12479	12540	17-35	14154	12359
Lan	Mean (SD)	28.82 (4.25)	30.50 (3.84)	30.29 (4.33)	30.08 (2.71)	31.19 (3.03)	31.038 (3.04)
	Range	17-34	19-35	16-36	25-37	27-40	24-37
VS	Mean (SD)	72.09 (21.03)	78.86 (19.29)	79.29 (19.70)	79.31 (18.18)	82.27 (17.56)	85.23 (13.22)
	Range	35309	36342	10-103	21-100	25-105	52-100
StR	Mean (SD)	5.91 (2.47)	6.96 (1.65)	7.05 (2.06)	6.69 (1.69)	7.23 (1.82)	7.65 (1.72)
	Range	0-9	3.0-9	2.0-10	3.0-10.0	4.0-14.0	4.0-10.0
GN	Mean (SD)	5.32 (1.89)	5.50 (1.95)	5.50 (2.06)	5.73 (1.49)	5.96 (1.69)	5.62 (1.63)
	Range	1.0-9	1.0-9.0	1.0-9.0	4.0-9.0	3.0-9.0	3.0-9.0
SR	Mean (SD)	3.64 (0.68)	3.80 (0.63)	3.76 (0.67)	3.76 (0.48)	3.82 (0.35)	3.82 (0.31)
	Range	1.2-4.0	1.2-4.0	1.2-4.0	1.8-4.0	2.6-4.0	2.6-4.0
Informal Measures							
DS1	Mean (SD)	62.55 (22.55)	73.41 (19.64)	75.00 (16.55)	69.35 (13.46)	75.38 (9.37)	75.65 (10.97)
	Range	35643	22-97	29-97	39-94	49-91	51-91
DS2	Mean (SD)	70.68 (21.26)	82.45 (14.34)	83.00 (13.86)	77.58 (10.46)	82.04 (9.40)	83.00 (8.09)
	Range	16-96	38-100	40-98	57-100	58-96	71-99
DS3	Mean (SD)	52.68 (22.37)	63.23 (21.87)	62.95 (21.07)	58.35 (13.82)	62.04 (13.55)	64.27 (15.73)
	Range	32599	35735	17-97	29-85	30-84	32-88
DS4	Mean (SD)	2.59 (3.03)	3.59 (3.31)	3.68 (3.07)	3.19 (2.33)	4.31 (2.47)	3.38 (2.19)
	Range	0-10	0-10	0-9	0-9	0-8	0-8
Maz	Mean (SD)	53.91 (34.53)	35.45 (23.91)	31.71 (15.53)	38.92 (30.01)	34.62 (26.26)	30.73 (19.45)
	Range	18-120	12-120	13-78	11-120	12-111	33208
SymM	Mean (SD)	96.73 (21.42)	93.64 (33.42)	96.27 (24.14)	86.92 (28.57)	81.96 (25.22)	84.50 (29.97)
	Range	60-120	50-180	46-140	45-130	45-120	10-120
StCo	Mean (SD)	7.06 (3.32)	8.82 (4.35)	9.81 (4.88)	9.27 (3.42)	10.39 (4.36)	11.23 (5.49)

	Range	1.0-14	0-17	2.0-19	4.0-15.0	3.0-19.0	2.0-22.0
TSP	Mean (SD)	11.86 (5.96)	13.36 (5.26)	12.43 (5.33)	14.42 (2.80)	14.86 (2.34)	15.46 (2.64)
	Range	0-18	0-19	0-18	9.0-20.0	11.0-20	11.0-20.0
FaR	Mean (SD)	16.32 (6.71)	17.77 (6.68)	19.67 (6.91)	15.50 (5.64)	19.42 (7.73)	19.04 (6.64)
	Range	0-29	12420	1.0-31	2.0-25.0	8.0-39.0	9.0-35.0
Note: CLQT: Cognitive Linguistic Quick Test; Att: Attention; Mem: Memory; ExF: Executive Function; Lan: Language; VS: Visuospatial Skills; StR: Story Retell; GN: Generative Naming; SR: Severity Rating; DS: Digit Span; Maz: Maze Time; SymM: Symbol Matching Time; StCo: Story Comprehension; TSP: Time-Related Story Math Problem; FaR: Facial Recognition							

Table 1: Formal and informal assessment measure scores for Individual and Group CT participants

Individual CT group: CLQT pre-post-PP results. For the Individual CT group, significant main effects were obtained on CLQT composite scores of Attention, F (2,21)=7.53, p=0.002; Language, F (2,21)=7.74, p=0.001; Visual Skills, F (2,21)=5.06, p=0.011; as well as the Story Retell subtest, F (1,21)=6.68, p=0 .12, p ements by agreements + .003; and overall CLQT severity rating, F (2,21)=6.67, p=0.003 (Tables 1 and 2).

	Individual		
	Pre-Po	Pre-PP	Po-PP
Formal Measure			
CLQT			
Att	0.33	0.38	0.04
Lan	0.42	0.3	0.1
VS	0.34	0.32	0.01
StR	0.5	0.51	0.05
SR	0.12	0.08	0.05
Informal Measure			
DS1	0.52	0.56	ns
DS2	0.66	0.6	ns
DS3	0.48	0.43	ns
Maz	0.63	0.83	ns
StCo	0.46	0.62	ns
TSP	0.27	0.09	ns
FaR	0.22	0.44	ns
Group			
	Pre-Po	Pre-PP	Po-PP
Formal Measure			
CLQT			
Att	0.29	0.55	0.24
StR	0.31	0.57	0.24
Informal Measure			

DS1	0.53	0.52	ns
DS	0.45	0.59	ns
DS3	0.27	0.4	ns
DS4	0.09	0.47	0.4
StCo	0.29	0.43	ns
FaR	0.59	0.58	Ns
Note: CLQT: Cognitive Linguistic Quick Test; Att: Attention; Mem: Memory; Lan: Language; VS: Visuospatial Skills; StR: Story Retell; SR: Severity Rating; DS: Digit Span; Maz: Maze Time; StCo: Story Comprehension; TSP: Time-Related Story Math Problem; FaR: Facial Recognition; ns: not signficiant			

Table 2: Cohen D effect size scores.

Individual CT group: informal measure pre-post-PP results. For the Individual CT group, significant main effects were yielded for the following informal measures DS1 F (2,21)=16.81, p<0.000; DS2, F (2,21)=22.67, p<0.000; and DS3, F (2,21)=8.74, p=0.001. A significant main effect was obtained for maze time, F (2,21)=7.09, p=0.002; story comprehension, F (2,21)=5.66, p=0.007; math story problems, F (2,21)=4.39, p=0.019; and face recognition, F (2,21)=5.57, p=0.007.

Group CT group: CLQT pre-post-PP results. For the Group CT participants, a significant main effect for testing interval was obtained on the following CLQT composites and subtest scores: Attention, F (2,25)=5.91, p=0.005, and Story Retell, F (2,25)=3.26, p=0.047 (Tables 1 and 2).

Group CT group: informal measure pre-post-PP results. For Group CT participants, the following informal measures yielded a significant main effect DS1, F (2,25)=5.45, p=0.0007; DS2, F (2,25)=4.93, p=0.011; DS3, F (2,25)=3.75, p=0.030; and DS4, F (2,25)=4.05, p=0.023. Also significant was story comprehension, F (2,25)=4.65, p=0.014; and face recognition, F (2,25)=4.72, p=0.013.

Pre-post gain differences

To further examine differences between Individual and Group CT outcomes, pre-to-post gain scores for each training group were computed. Measures of pre-to-post gain were quantified in terms of difference scores, which were computed for CLQT test scores and informal measures by subtracting pre training scores from post training scores for each assessment measure. See Table 3 means, standard deviations and ranges of difference (gain) scores for formal and informal assessment measures. The difference scores were compared using a series of one-way between subjects ANOVAs. Significant results were only obtained for two measures. For DS2 F (1,47)=7.61, p=0.012, higher gain scores were obtained for Individual participants (M=11.77, SD=10.41) than Group participants (M=4.46, SD=9.68). Similarly, DS3 gain scores, F (1,47)=5.50, p=0.029, were higher for Individual (M=10.55, SD=13.38) than Group participants (M=3.69, SD=13.18).

Measure		Individual	Group
CLQT			
Att	Mean (SD)	13.82 (27.39)	11.85 (23.68)
	Range	21.0-95.0	-34.0-63.0
Mem	Mean (SD)	7.27 (15.95)	4.15 (22.12)
	Range	-19.0-44.0	-27.00-72.00
ExF	Mean (SD)	1.78 (3.80)	0.81 (5.90)
	Range	-5.0-9.0	-11.0-14.0
Lan	Mean (SD)	1.68 (2.19)	1.12 (2.60)
	Range	-2.0-7.0	-3.0-9.0
VS	Mean (SD)	6.77 (12.16)	2.96 (13.50)
	Range	-15.0-40.0	-28.0-32.0
StR	Mean (SD)	1.05 (1.70)	0.54 (2.20)
	Range	-3.0-4.0	-3.0-7.0

GN	Mean (SD)	0.182 (1.097)	0.231 (1.275)
	Range	0.182 (1.097)	0.231 (1.275)
SR	Mean (SD)	0.15 (0.24)	0.06 (0.37)
	Range	0.0-0.8	-0.4-1.6
Informal Measures			
DS1	Mean (SD)	10.86 (11.44)	6.04 (8.94)
	Range	-8.0-32.0	-13.0-20.0
*DS2	Mean (SD)	11.77 (10.41)	4.46 (9.68)
	Range	4.46 (9.68)	-11.0-25.0
*DS3	Mean (SD)	4.46 (9.68)	-11.0-25.0
	Range	-18.0-36.0	-33.0-26.0
DS4	Mean (SD)	1.00 (3.34)	0.192 (2.19)
	Range	-9.0-9.0	-4.0-5.0
Maz	Mean (SD)	-18.45 (30.66)	-4.31 (30.41)
	Range	-87.0-30.0	-71.0-100.0
StCo	Mean (SD)	1.77 (3.56)	1.12 (2.35)
	Range	-5.0-7.0	-4.0-6.0
TSP	Mean (SD)	1.50 (2.39)	0.46 (2.35)
	Range	-3.0-6.0	-3.0-5.0
FaR	Mean (SD)	1.46 (4.56)	3.92 (8.66)
	Range	-6.0-13	-4.0-37.0
Note: CLQT: Cognitive Linguistic Quick Test; Att: Attention; Mem: Memory; ExF: Executive Function; Lan: Language; VS: Visuospatial Skills; StR: Story Retell; GN: Generative Naming; SR: Severity Rating; DS: Digit Span; Maz: Maze Time; StCo: Story Comprehension; TSP: Time-Related Story Math Problem; FaR: Facial Recognition; *Significant CT group difference at p<0.05.			

Table 3: Pre-post difference (gain) scores, standard deviations and ranges.

Pre-training abilities and post-training outcomes relationships: Correlational relationships between participants' initial memory, language and cognitive status, and the amount of progress (or lack thereof) at post testing were examined. Pearson correlations were used to determine the degree to which pre-training (baseline) age, CLQT and informal measure scores, correlated with pre-post difference (gain) scores, across both groups.

Initial correlational analyses were conducted to determine if participants' incoming levels of function, as measured by CLQT baseline scores, were individually related to performance gains on informal measures. Participant gain scores for DS1 (r=-0.30, p=0.035) and DS2 (r=-0.386, p=0.007) were negatively correlated with baseline CLQT Language composite scores. Similarly, DS1 (r=-0.33, p=0.021) and DS2 (r=-0.32, p=0.025) gain scores correlated negatively with CLQT Generative Naming baseline scores. On the other hand, story comprehension gain scores reflected a positive relationship with baseline Executive Function composites (r=0.31, p=0.034. Chronological age negatively correlated with DS2 (r=-0.34, p=0.018) and face recognition (r=-0.30, p=0.034) gain scores. Across informal measures, a negative correlation was obtained between baseline story comprehension and DS1 (r=-0.28, p=0.047), as well as baseline math problem solving and DS1 (r=-0.38, p=0.016). Yet a positive relationship existed between baseline math problem solving and story comprehension gain scores (r=0.36, p=0.012).

To explore whether participants' entry level abilities in specific domains predicted the amount of success achieved in that corresponding domain after training, correlations between baseline scores and gain scores from specific CLQT and informal measures were computed. Across CLQT composites and subtests, several negative correlations were revealed between participant baseline ability on a particular measure, and the amount of gain reflected on that measure at post training. Specifically, baseline scores in Attention (r=0.46, p=0.001), Memory (r=0.62, p<0.000), Executive Function (r=0.39, p=0.005), Language (r=0.39, p=0.006), Visual Skills (r=0.43, p=0.002), and Story Retell (r=0.64, p<0.000) were negatively correlated with pre-post gain scores for each of these measures. Similarly, the same correlational trend was reflected with a number of informal measures indicating that the lower the baseline scores, the larger the

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training gains. Negative correlations were obtained for baseline and post training difference scores for DS1 ($r=0.59$, $p<0.000$), DS2 ($r=0.70$, $p<0.000$), DS3 ($r=0.42$, $p=0.003$), DS4 ($r=0.49$, $p<0.000$), math problem solving ($r=0.52$, $p<0.000$), and face recognition ($r=0.41$, $p=0.004$).

Cognitive function aging survey results

Cognitive function surveys for 47 participants were filled out immediately before and following training, indicating how often (Always, Sometimes, Rarely) participants experienced negative perceptions about their abilities in various types of cognitive, memory, attention and communication related situations. Depending on how participants responded to questions before and after CT, their perception of the effectiveness of CT was inferred. For example, if a participant responded Always to a question on the pre-training survey, and then responded Sometimes or Rarely on the same question, post training, that would indicate an increased positive perception of their ability in that specific situation. As such, participant responses for each of the 23 items were compared at pre and post training intervals.

	Individual			Group		
	Mean	SD	Range	Mean	SD	Range
Rating						
Improve	3.52	2.02	42948	4.89	3.39	0-13
Regress	6.62	4.2	0-18	4.12	3.77	0-16
No Change	12.81	3.98	4-20	13.96	3.67	7-23

Table 4: Cognitive Function survey results indicating improvement or regression from pre to post ratings.

The number of increased positive and negative perceptual trends for each item was computed, as well as the number of responses that remained the same from baseline to post training. Table 4 shows the mean number of responses that reflected improvement, decreased functioning, and no change for each CT subject group. A 2 × 2 mixed model ANOVA with CT group serving as the between-subject variable and pre-post CT rating changes (i.e., indicating progress, regression), serving as the within-subject variable indicated no significant main effects, but a significant interaction, $F(1,45)=6.06$, $p=0.017$. Least significant difference testing at the 0.05 level indicated that Individual participants had more post training ratings reflecting a regression in perceptions of ability ($M=6.62$, $SD=4.20$) than ratings reflecting increased abilities ($M=3.52$, $SD=2.01$) ($d=0.99$). Furthermore, more post-training perceptual ratings reflecting a regression in abilities were made by Individual ($M=6.62$, $SD=4.20$) than Group ($M=4.11$, $SD=3.76$) participants ($d=0.63$).

Satisfaction survey results

Post CT satisfaction surveys were received back from 46 participants. Only one participant left one question unanswered, and all others provided responses to all 16 questions for a total of 735 responses. The survey was designed so that the higher the rating, the more positive a participant felt about his/her improvement as a result of training. In this way, a rating of 4 (i.e., strongly agree) would reflect the highest rating of a participant's perception of his/her abilities; and conversely, a rating of 0 (i.e., strongly disagree) would reflect the lowest rating or most negative perception a participant would have of a specific ability. The frequencies of each rating (1-4) for the 16 questions, for Individual and Group participants are listed in Table 5, as well as Mean ratings and SDs for each question. Upon examination of qualitative data, it was determined that the most frequent rating for the 16 questions was a 3 (agree) for the Individual CT group ($M=10.12$, $SD=3.46$), and the Group CT group ($M=13.31$, $SD=2.79$). Questions 13 and 16 received the highest frequency rating 4 (strongly agree), for both groups, indicating that participants were happy they participated in CT, and would recommend the program to others. Questions having a slightly higher number of 1 (disagree) ratings for both CT groups were 9 (solving math problems and computation) and 10 (remembering new faces), and 11 (remembering verbal information) for the Group condition. Yet the frequency of a 1 (disagree) rating was very low across both Individual ($M=0.93$, $SD=0.99$) and Group ($M=2.25$, $SD=1.39$) groups. A total of 2 (strongly disagree) ratings were recorded across all surveys.

	Individual Rating						Group Rating					
Question #	4	3	2	1	Mean	SD	4	3	2	1	Mean	SD
Q1	2	16	3	0	2.95	0.49	1	14	7	3	2.25	0.77
Q2	3	10	7	1	2.71	0.78	3	13	6	2	2.71	0.8
Q3	5	6	8	1	2.61	1.07	0	13	8	3	2.32	0.85
Q4	2	12	6	2	2.71	0.71	1	15	6	2	2.6	0.66
Q5	1	12	6	2	2.57	0.74	0	16	6	3	2.52	0.71
Q6	2	11	7	1	2.66	0.73	1	8	12	3	2.28	0.73
Q7	1	13	6	1	2.66	0.65	2	16	6	1	2.76	0.66
Q8	5	11	4	1	2.95	0.8	4	14	6	1	2.84	0.74
Q9	3	8	6	3	2.42	1.07	1	12	8	4	2.4	0.81
Q10	2	11	5	3	2.57	0.87	3	10	8	4	2.48	0.91
Q11	2	11	8	0	2.71	0.64	2	13	5	5	2.48	0.91
Q12	5	9	5	1	2.9	0.85	2	18	3	2	2.8	0.7
Q13	18	3	0	0	3.85	0.35	15	8	1	1	3.48	0.77
Q14	3	16	5	1	2.95	0.59	3	14	4	0	2.84	0.68
Q15	6	14	2	1	3.28	0.64	8	11	2	0	3	0.76
Q16	11	13	1	0	3.81	0.4	17	4	0	0	3.4	0.57

Note: Q: Question number; 4: Strongly agree; 3: Agree; 2: Neutral; 1: Disagree

Table 5: Number of satisfaction survey ratings 1-4 for each question, and mean rating for each question.

Discussion

Overall cognitive training effectiveness

The overall results of this investigation indicate that prevention training in a university clinic setting; incorporating multiple types of memory, cognitive, problem solving, language and other tasks can have a positive impact on typically aging seniors' abilities across different skill areas. Upon broad inspection of the results, it appears that a number of patterns emerge. One is that on virtually every CLQT and informal measure, an average (mean) upward trend was noted in participant performance from pre to post training, and furthermore, performance levels were maintained for a several weeks after training. Whereas relatively small effect sizes were yielded for many training gains, upon examination of the adult CT research literature, it becomes apparent that relatively small effect sizes are not unique [28]. Consistent with other studies [29] was the fact that more significant pre-post training differences, and higher effect sizes were revealed for targeted cognitive tasks (i.e., informal measures) than for formal test composites (i.e., CLQT) by group trained participants. Efforts were made to evaluate participant performance from a number of angles, including an overview of collective results across CT groups, as well as between and within CT groups. Participant results indicated that significant gains were made collectively in attention; language and story retell, and maintained approximately 12 weeks post-training, as measured by the CLQT. Other significant gains across CT groups were revealed for Digit Span memory, maze completion rate, story comprehension and recall, and face recognition; which were also maintained 12 weeks post-training. The significant gains across both groups in attention and language were not surprising given the number of training activities focusing on tasks that required such skills. A majority of the training tasks required increased attention on auditory and visual stimulus material, such as Digit Span memory, list recall and manipulation, and numerous other visual-spatial recall and reproduction activities.

As for the informal measures of Digit Span memory, maze time, story comprehension, and face recognition, gains from pre to post training across both CT groups were not surprising because these skills were addressed in some way during each training session. The fact however that these gains were maintained several weeks after training ceased, and in some cases were even magnified, was a true indication of the CT's robustness. Given that most participants' ages and general lifestyles purportedly required less cognitive and memory demands than that elicited during CT, the maintenance of sharper skills long after completion of CT is noteworthy.

Individual and group training differences

Upon examination of each CT group's testing scores from pre to post to PP testing intervals, it was apparent that differential outcomes were reflected by each group. In terms of CLQT measures, the Individual CT group made significant gains from pre to post training in attention, language, visual skills, story retell and overall severity ratings on the CLQT. These gains were all maintained at PP testing intervals as indicated by the lack of significant difference between post and PP testing scores. As for the informal measures, Individual CT participants made significant gains on all measures including each Digit Span memory measure, story comprehension, maze time, math story problem solving and face recognition. As was the case with the CLQT measures, post gains were maintained approximately 12 weeks or more beyond training.

Contrastively, Group CT participants made significant gains on two CLQT measures of attention and story retell. Even though CLQT language scores collectively improved across both groups, this did not improve significantly on the Group CT within-group analyses. More similar to Individual participants, the Group participants improved significantly on measure of Digit Span memory, story comprehension and face recognition. As was the case with the Individual group participants, all gains were maintained or even exaggerated 12 weeks post-training by Group participants. Collectively, even though Group participants performed higher on a number of CLQT and informal measures across testing intervals, Individual participants showed significant gains on a higher number of pre-post training measures. This could be related to the fact that Individual participants came into the study with relatively lower baseline scores. This finding is similar to Oliveira et al. [24], who found that lower scoring elderly adults in long-term care institutions demonstrated significantly more improvement after completing a cognitive stimulation program than did noninstitutionalized, higher functioning adults.

The higher number of significant pre-post performance increases demonstrated by the Individual CT group may be a product of other extraneous factors such as high subject variance, or possibly, increased ceiling effects in Group CT participant performances. The plausibility of a ceiling effect was supported by the fact that a higher number of significant increases in post testing scores were obtained for informal measures than for CLQT composites. This may be attributed to the fact that the informal measures were designed to be relatively difficult for most persons (at any age) to achieve maximum percentages of accuracy, thus preventing the likelihood of a ceiling effect, per say, on these measures. As the results suggest, a number of participants, especially in the Group CT performed at or near the upper limits on CLQT measures, thus leaving less room for measurable improvement. On the other hand, relatively low baseline scores on informal measures, which were more evident in individual participants, left potentially more room for measurable progress, and less likelihood of a ceiling effect.

To further delineate Group versus Individual differences, the degree of difference in each measure from pre to post testing (gain scores) was examined. Difference scores were compared between the two groups to determine if one group's gains were more pronounced. Virtually both groups demonstrated comparable degrees of gain from pre to post training on all cognitive, memory and language measures except for on 2 indices of Digit Span memory. Based on this finding it could be concluded that Individual and Group CT participants benefitted similarly from each CT training regimen.

Correlational interpretations

Due in part to the rather heterogeneous findings across senior participants in this study, specific correlational analyses was conducted to uncover possible predictors of CT success. Only a few positive correlations were revealed between participant pre-training abilities and gains displayed after training. The finding that most baseline CLQT composite scores did not predict success on most measures is consistent with findings across the CT literature [30] indicating that initial cognitive status did not correlate with pre to post CT cognitive changes. On the contrary, many more negative (or reverse) relationships were uncovered between participant baseline abilities and gains made from pre to post testing. For the most part, if participants scored lower on each of the CLQT major composites including, attention, memory, language, executive functioning and visual skills, they demonstrated higher gain scores post training on each of the composites, as was also the case with the subtest of story retell. Similarly, for informal measures of Digit Span memory (1-4), math story problem solving and face recognition, the lower participants scored at baseline, the higher was their amount of improvement post training. It stands to reason that other negative pre-post performance relationships would follow. As such, negative pre-post performance correlations were found between CLQT language/generative naming, and Digit Span [1-2], as well as story comprehension/math problem solving and Digit Span 1.

In terms of the relationship between age and training outcomes, it was anticipated that more significant relationships might emerge. Surprisingly, age significantly correlated with only 2 measures, Digit Span [2] and face recognition, and again these relationships were negative. The lack of more significant age correlations is somewhat consistent with the position by Leung et al. [30] that the neural plastic potential of the brain continues into older age, as indicated in his training study, whereby baseline cognitive/age status did not correlate with pre to post training changes. Based on Leung et al. and this study, the thinking that older adults, who theoretically are at greater risk for cognitive decline, will not benefit from CT, is cautioned against as the findings essentially do not support any age limits for predicting CT success.

Furthermore, the more reduced an elderly person's abilities were in a particular skill set, the more progress they were likely to make in that skill area. Alternatively, if an elderly person's abilities were sharper in a particular domain, the less potential for progress was indicated. To interpret this in yet another way, a ceiling effect may have been operating in some of the seniors with relatively higher entry level abilities. Even though the author strived to create CT activities that would cater to all conceivable skill levels (based on pilot CT programming), it was noted that certain activities were relatively difficult for some seniors to master, while not presenting a challenge for others. In these instances, students were taught various ways to modify levels of complexity when presenting different CT activities.

Participant survey findings

Results from the Cognitive Function Survey indicated that Individual CT participants viewed their progress after training less positively than did their Group CT counterparts, as indicated by the number of survey items that were rated more negatively by Individual than Group participants on pre to post training surveys. This finding is similar to that of the limited studies comparing individual and group CT training regimens [18,19], wherein group trained participants were more likely to report positive perceptions of their memory performance following training. At first glance these findings did not make intuitive sense, because the case can be made that the Individual CT participants made as many or more significant gains in their post training abilities than did Group CT participants. Furthermore, it was also considered as a negative referendum of sorts on the Individual CT program. However, after considering certain anecdotal commentary made by different participants in both groups, the regression in perceptions rated on post Cognitive Function surveys can be reconciled.

It is believed that a number of participants became more aware of their challenges and/or declines in certain memory, cognitive and language abilities. The CT was designed to challenge senior participants and to push them outside of their comfort levels. Because the Individual participants may have entered training with relatively lower abilities, the CT regimen may have presented a relatively greater challenge to them than it did with Group CT participants. As such, Individual CT participants may have perceived their various memory, cognitive and language skills more negatively following training, while Group participants felt more comfortable with their performance and progress made in the CT program. Or, it could be that because Group participants were surrounded by other seniors with higher and lower skill levels during training, they tended to regard their personal skills in a relatively more positive light. Less focus was placed on individual skills, and more on group activities during the Group CT sessions, possibly resulting in less critical perceptions by each group participant of their own abilities.

Somewhat in contrast to Cognitive Function perceptions, findings from the Satisfaction Survey (SS) indicated that participants in both CT groups, strongly agreed or agreed that various aspects of their memory, cognitive, language and attentional skills, and associated confidence, had improved after CT. In fact 71 and 67 percent of SS responses by Individual and Group participants respectively indicated strong agreement or agreement that improvement had been made. A majority of Individual and Group participants indicated a strong agreement, or agreement, that they were glad they participated in the CT program, and would recommend it to another senior (SS questions # 13, 16). Interestingly, a higher percentage of Individual CT participants indicated a strong agreement to these two questions (86% and 81%) than did Group participants (60% and 44%), thus quelling concerns about the Individual CT participants' overall satisfaction with their training experience. A tendency for individual participant perceptions regarding progress (or lack thereof), to align with the more objective pre-post progress measures, was not evident in this study, an issue which merits further examination.

Clinical implications

The clinical implications that can be derived from this study are numerous. Based on results from this study, the efficacy of CT in a university clinical setting is evidenced in both individual and group training formats. In terms of the provision of CT experiences in a university based setting, clinical implications regarding efficiency may be equally as important as efficacy. Arguably, if university speech and hearing clinics have the resources available to provide individually centered memory-cognitive preventative training measures, results of this study support those efforts. However, it is believed that for a number of reasons, a CT prevention program implemented in a group context may be more efficient than providing one-on-one prevention services in a university setting. The group CT regimen was relatively easy to implement in terms of time, physical space and personnel requirements. It was held once per week in a classroom setting, and utilized one lead trainer (administering activities to whole group), with the addition of a number of student SLPs (e.g., one student with 1-3 seniors) who earned valuable clock hours. Participating student clinicians were positioned to gain a better understanding of a variety of concomitant issues that seniors bring to the clinical arena, such as loss of hearing, vision and mobility skills, as well as other personal issues (e.g., loneliness, boredom, poor health). Anecdotally, students reported that the CT experience helped prepare them and/or become more effective with their adult clinical patients, as it fostered a better understanding of a wide array of clinical training materials and strategies. Earned clinical clock hours were commensurate with ASHA clinical prevention training guidelines and Standards V-B (ASHA 1a and 2c).

In terms of choosing CT training materials a number of activities were adapted from existing materials commonly found within a typical SLP armamentarium (e.g., WALC workbooks), while other activities were designed by the author (e.g., face photos creating a wedding party), and others taken from existing internet sources (e.g., visual-spatial memory exercises). Given the outcomes of previous studies in conjunction with the present study, certain recommendations can be made. It is plausible to implement numerous types of activities across different memory, cognitive and language domains that are delivered at a rapid pace and in short durations (i.e., 1-5 minutes). Participants in this study remained well engaged and actively focused during both CT regimens, suggesting that two-hour CT duration is tolerable given a wide variety of brief, thought-provoking mental exercises.

The implementation of a prevention regimen like that used in the current study would probably be intuitive for many SLPs, especially those experienced with adult and geriatric populations. However, the issue regarding an SLP's role in prevention programming begs the question, "what's in it for us as a profession?" While SLPs are reimbursed exclusively for identification, remediation and rehabilitation services with the elderly, the idea of prevention may seem as an ideological and unrealistic amenity that is not within our professional reach. However, as the shift in population trends progress, the implementation of preventative services may actually become a more integral aspect of third party healthcare guidelines and reimbursements. Various reports have underscored the importance of following a prevention health model for older adults and specific examples provided as to how CT can potentially reduce health care costs [31]. It is conceivable that one of the first reforms in reimbursement for preventive services may be instituted for populations of seniors with MCI. The Diagnostic Statistical Manual-5 (DSM-5) has included a category called 'mild neurocognitive disorder (mNCD) that is characterized similarly to MCI, and on which the focus is decreasing progression to a major neurocognitive disorder such as dementia or Alzheimer's. In the present study, the finding indicating that the lower a senior's baseline skill levels were on various measures, the higher the gains were on post testing measures has important clinical ramifications for populations of aging seniors showing signs of mild cognitive impairment. Thus, a clinician should not operate under the premise that the more cognitively challenged an elderly person is, the less they may be able to benefit from a CT program. This notion has been refuted by other training efforts as well as neuroimaging studies [12,31,32] indicating the neuroplasticity potential of the aging brain.

A CT prevention program such as that used in this study may provide an effective memory-cognitive health service eventually recognized as an acceptable ICD-CPT billing code for which the SLP profession is well equipped to provide. Medicare currently endorses the screening of beneficiaries for cognitive impairment as part of an annual wellness visit. It is believed that as mandates for the care of elderly adults emerge, the SLP profession should be armed with a substantial evidence base supporting preventative types of service delivery models that are uniquely suited for our clinical discipline. In this way, the SLP profession can position itself at the forefront of the prevention trend in research, practice and policy. While SLP professionals have focused pre-service clinical training and preventative services on young children for years, we may be overdue in our efforts to place more focus on the opposite end of the age spectrum.

Study weaknesses and future directions

As with most other training studies, this one was not without challenges and potentially confounding influences. Although public service announcements emphasized that the Senior MINDS program was for typically aging elderly adults, baseline measures indicated that some of the seniors may have had MCI or borderline MCI, thus creating an increased heterogeneity across participants. While considerable variation was noted throughout participants, it is conceivable that the subject pool in this study was relatively representative of most cross sections of typically aging seniors. In future investigations of CT efficacy, subject heterogeneity should be carefully controlled, or larger studies may be conducted which identify potential predictors of success in cross sections of senior populations.

Another aspect of this study that might be regarded as a weakness was the lack of a no-treatment control group. Given the plethora of studies that have already demonstrated significant CT training effects when controlled to no-treatment control groups it was deemed more informative for this study to examine individual versus group CT outcomes because both are commonly employed in a university setting. Furthermore, a control group for this feasibility study was ultimately not included due to the prevailing interest of senior participants to receive CT without delay. It would be informative to utilize a no-intervention control group in a future study to determine if control participants made any gains in test scores at post and PP testing intervals. Because significant differences did not exist between most post and PP testing measures, a pre-post-PP test familiarity effect was considered unlikely. Had test familiarity played a significant role, then one might expect relatively higher scores on PP measures than on post testing measures.

Another factor in this study that merits further consideration is the difference in Individual and Group CT session length and frequency of occurrence. Although total training time was equivalent between the two groups, the fact that Individual CT participants were seen twice weekly, may have been why they made more statistically significant gains. The rationale for the scheduling variation was based on the view that a two-hour, one-on-one training session might have been too intense or overwhelming for Individual participants. The spacing of the individual training may have added some benefits for the individual participants in that there was less time in between each training session (therefore allowing more frequent practice of material). Little research addresses the intensity and/or spacing of training in memory-cognitive prevention programs, which warrants further examination. A possible related artifact of the group versus individual CT is the issue of distraction. In the current study, the Individual CT training context may have been more facilitative, simply due to the ostensible lack of distraction as compared to the busier and nosier Group CT setting. It has been suggested that distraction, and the decreased ability to focus without being distracted is one of the hallmarks, and conceivably one of the principal challenges to an elderly adult learner [33,34].

Most importantly, future investigations should focus on the generalization of CT effects to everyday living environments and to functional memory-cognitive skills. As suggested by Könen and Karbach [35], further examination of within-individual training outcomes would be highly informative in assessing the impact of CT activities on individual participants and their daily living activities. In the current study, efforts were made before and after CT, to survey senior participants' perceptions of various memory and cognitive abilities as they pertained to everyday activities. This may be one way to asses in a cursory fashion how CT programming may effect a senior's everyday functioning. In essence, as critics of the CT research literature emphasize, much more work is needed in delineating the effects of specific doses of CT training, exploring ecologically viable interventions, and impacting general cognitive skills rather than task-specific, cognitive-memory skills.

In conclusion the present feasibility study is one of hundreds that have documented the effects of memory-cognitive training efforts with aging seniors. Unlike others however, this feasibility study was intended to serve as a jumping off point for SLP professionals seeking to establish a similar type of prevention model in an academic setting. The relative ease of implementation, minimal time and resource investment, as well as participant progress and satisfaction associated with the Group CT program in this study constitute reasons why a similar group or individual prevention model can be efficacious for SLP training programs. It is believed that SLP professionals have expertise and are well-positioned to engage in investigative and clinical efforts focused on preventative memory, cognitive and language health initiatives for the elderly [36,37].

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