Development of a cognitive training program for the elderly

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Abstract

Introduction: Plasticity in intellectual functioning has been the target of significant research investment. Among non-pharmacological interventions, cognitive training appears as a promising option for delaying the effects of aging on cognition. *Objective:* The present study describes the procedures of a cognitive training program for healthy Brazilian elderly persons (without diagnosis of dementia). *Method:* Cognitive tasks for the training of attention, processing speed, episodic memory and working memory were carried out. The program training was performed over 12 individual sessions, and included an Instruction Book, a Stimulus Book and Protocol Record. To assess the effects of training, five subtests of the WAIS-III test were used: Picture completion, Coding, Arithmetic, Matrix Reasoning and Digit Span. The cognitive training program was tested with 15 individuals, divided into an experimental group (EG), which received training, and a control group (CG). The EG was formed of seven participants, aged between 70 and 82 years (M=73.57, SD=4.11) and with an average schooling of 5.8 years (SD=1.02). The CG was formed by 8 participants, aged 69-77 years (M=74.00, SD=4.58), and who had an average schooling of 2.88 years (SD=2.58). *Results:* Repeated measures ANOVA revealed a training effect for three subtests: Coding: [F(1)=5.40, p=0.03, η2G=0.09], Arithmetic [F(1)=9.03, p=0.01, η2G=0.004] and Picture completion [F(1)=8.01, p=0.01, η2G=0.19]. There were no gain effects for Matrix Reasoning [F(1)=1.43, p=0.25] and Digit Span [F(1)=10.04, p<0.001]. *Conclusion:* The results of this pilot study show the importance of testing the impact of cognitive training through a randomized clinical trial to verify its effects on the mental performance of older adults. The importance of greater disclosure in literature of the construction procedures involved in cognitive training tasks, as well as the formulation of intervention strategies, is highlighted.

Keywords: Elderly. Cognition. Cognitive Training

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INTRODUCTION

In the extensive field of non-pharmacological interventions for the elderly population, cognitive interventions are becoming increasingly popular. This procedure involves the training of specific cognitive mechanisms in standardized tasks that represent a direct and experimentally controlled method of investigating the degree of plasticity in intellectual functioning during the aging process.[1] One underlying assumption about cognitive interventions is that performing mental exercises and using cognitive learning strategies can improve or (at least) preserve the functioning of a determined domain. Another assumption is that the effects of this practice will be generalized beyond the immediate context of the intervention. The importance of the assessments of the impact of cognitive interventions on the mental performance of elderly individuals has increased over the last decade.[2-5] The results suggest that proper interventions produce learning effects, an improved performance in the skills targeted in the intervention and (less frequently), generalized gain effects for the different contexts of the intervention (such as daily activities) and transference effects for non-trained cognitive abilities.[6-10] There is also evidence of the positive impact of these interventions on the performance of elderly individuals with accentuated mental decline due to dementia, suggesting the possibility of assuaging and/or delaying cognitive impairment, although the scope of the interventions is more limited when compared with non-clinical groups.[11-13]

There is some confusion about the terms commonly used to define the different types of cognitive interventions for the elderly.[14,15] Literature contains several different terms to describe intervention techniques, of which the most common are cognitive stimulation, cognitive training and cognitive rehabilitation. Despite the fact that these terms are often used in a way that would suggest that they are synonymous, they actually differ in terms of the methodology used.[16] This low level of concordance in relation to the use of terminology has hindered meta-analysis studies, which seek to correctly classify the type of intervention reported by the authors. An attempt to create a taxonomic reference was initiated by Clare et al and subsequently discussed and revised by Belleville, Mowszowski et al. and Bahar-Fuchs, Clare & Woods. Based on these studies, the following classifications have been made[17,18]:

1) Mental stimulation: also known as brain training, this refers to the repeated performance of standardized tasks, often carried out using computerized formats or games.[19] This type of intervention is quite common in neuropsychological bias approaches and is characterized by the commercialization of products in the form of games, which are sometimes available via websites.* A significant characteristic of brain training is the absence of a structured and managed learning situation, since this type of training seeks to involve the individual in a situation of mental effort through the performance and repetition of tasks. Given that learning strategies involve little effort, mental stimulation has become a powerful tool in interventions with clinical groups. [20]

2) Cognitive training: this type of intervention is centered on the performance of a set of standardized tasks that reflect certain cognitive functions, including memory, attention, problem-solving, reasoning and processing speed, among others. This type of intervention can be unimodal, which focuses on the training of a specific ability (for example, episodic memory), or multimodal, which trains several cognitive abilities. The stimuli used can be of the "pencil and paper" variety, or may be computerized. It is also common to include activities of daily living.[21,22] The performance of activities can be completed individually or in groups,[23] or even with family members.[24] It differs from mental stimulation in that the participants are taught a number of strategies to optimize their mental functioning.

* Ex: http://www.sharpbrains.com and http://www.luminous.br

3) Cognitive rehabilitation: this type of intervention is aimed at clinical groups and is typically characterized by involving the patient in a range of general activities (including cognitive stimulation) and discussions (commonly performed in groups). The main aims of cognitive rehabilitation are to obtain a general improvement in daily cognitive and social functioning[25] and to help patients with early or moderate dementia to get the best out of their memory and cognitive functioning, despite the difficulties they are facing.

Cognitive training can be conducted in different formats, which vary in relation to the following aspects: 1) the modality used - individual or collective sessions; 2) the target abilities – multi-domain interventions stimulate cognitive abilities in different domains, whereas in a unimodal intervention the target abilities are in the same cognitive domain; 3) the format of the stimuli – "pencil and paper" activities or computerized tasks; 4) cognitive measurements – the measurements can focus on the target abilities of the intervention (the aim of the training), in order to investigate the effects of proximal (near transfer) transference, or non-trained abilities, in order to investigate the effects of distal (far transfer) transference; 5) the follow-up period – long-term monitoring examinations determine the temporal durability effects of the intervention.

Evidence related to the effectiveness of cognitive training programs for the elderly began to appear on the international scene in the 1980s, when the main focus was on investigating the possibility of reversing age-related decline using cognitive psychometric tests.[26-28] One of the most significant pioneers studies was the Seattle Longitudinal Study (SLS).[29] The fifth cycle of the SLS (1984) included a significant contribution by Sherry Willis, who introduced the paradigm of cognitive training to the project.[27]

In the 1990s, one of the most significant randomized clinical trials of cognitive training for the elderly was conducted. The study in question was known as ACTIVE *(*Advanced Cognitive Training for Independent and Vital Elderly) and was conducted between April of 1998 and December of 2004. This project was coordinated by the New England Research Institute (NERI) and covered six metropolitan regions in the USA.[9,11,30,31] Each intervention group received 10 training sessions for one of the three cognitive abilities: 1) episodic memory training (n=711); 2) reasoning training (n=705); and 3) processing speed training (n=712). The control group contained 704 participants. Four booster training sessions were conducted 11 and 35 months after the original training program in 60% of the sample (for each of the intervention groups). The results indicated an improvement in all of the abilities that were trained in each group (p<0.001), with temporal stability of two and five years. The ten-year monitoring session confirmed gain maintenance effects in the abilities trained, although only for reasoning and speed. As yet, there is no international consensus concerning the impact of these intervention programs,[2,32] although the extensive number of studies has led to the initiation of meta-analysis studies and systematic reviews of evidence from the 1990s [33] until the current day.[13,23,34-38]

In Brazil, studies of cognitive training for the elderly began in the year 2000 with a study by Guilherme Wood.[39] A national literature review was conducted in the Scielo, PsycINFO and PubMed databases between January 1990 and July of 2015 using the following (Portuguese and English) terms: cognitive training; cognitive stimulation; aging; the elderly and Brazilian. Theses and dissertations that were available in digital libraries were also used. In total, 21 national experimental studies were identified. Chart 1 displays the data related to these studies.

Chart 1. Report of national experimental studies. Vitória da Conquista, BA, 2014.

Aramaki FO, Yassuda MS. Cognitive Training based on metamemory and mental images: follow-up evaluation and booster training effects. Dementia and Neuropsychology, 2011; 5(1): 48-53.
[a,b]Brum PS. Treino de memória para idosos saudáveis e com comprometimento cognitivo leve: benefícios sobre parâmetros cognitivos (Dissertação). São Paulo: Faculdade de Medicina, Universidade de São Paulo; 2012.
Carvalho FC, Neri A, Yassuda MS. Treino de Memória Episódica com ênfase em categorização para idosos sem demência e depressão. Psicologia: Reflexão e Crítica , 2010; 23(2): 317-323
[b]Chariglione IPF (2010).A influência de diferentes tipos de treinos cognitivos na memória de idosos institucionalizados (dissertação). Brasília (DF): Programa de pós-graduação em ciências do comportamento, Universidade de Brasília; 2010.
Chariglione IPF. Intervenções cognitivas para o aprimoramento da memória em idosos com envelhecimento cognitivo normal (Tese). Brasília (DF): Programa de Pós-Graduação em Ciências do Comportamento, Universidade de Brasília, 2014
[a]Irigaray TQ, Filho IG, Schneider RH.. Efeitos de um treino de Atenção, Memória e Funções Executivas na cognição de idosos saudáveis. Psicologia: Reflexão e Crítica, 2010; 25(1): 188-202.
[b]Irigaray TQ, Filho IG, Schneider RH. Efeitos de um treino de Atenção, Memória e Funções Executivas na cognição de idosos saudáveis. Psicologia: Reflexão e Crítica, 2010; 25(1): 188-202
Irigaray, T. Q., Schneider, R. H., & Gomes, I. (2004). Efeitos de um treino cognitivo na qualidade de vida e no bem-estar psicológico de idosos. *Psicologia: Reflexão e Crítica*, 24(4), 810-818.
[a,b]Lasca VB. Treinamento de memória no envelhecimento normal: um estudo experimental utilizando a técnica de organização (Tese). São Paulo: Universidade Estadual de Campinas; 2003.
[b]Lima-Silva TB, Yassuda MS. Treino cognitivo e intervenção psicoeducativa para indivíduos hipertensos: efeitos na cognição. Psicologia: Reflexão e Crítica, 2010; 25(1): 30-40
Lima-Silva TB, Ordonez TN, Santos GD, Fabricio AT, Aramaki FO, Almeida EB, et al Effects of cognitive training based on metamemory and mental images. Dementia and Neuropsychology, 2010; 4(2): 114-119.
[b]Lima-Silva TB, Oliveira ACB, Paulo DLV, Malagutti MP, Danzini VMP, Yassuda MS. Treino cognitivo para idosos baseado em estratégias de categorização e cálculos semelhantes a tarefas do cotidiano. Revista Brasileira de Geriatria e Gerontologia, 2011; *14*(1): 65-74.
[b]Olchik MR. *Treino de memória: um novo aprender no envelhecimento* (Tese). Porto Alegre: Universidade Federal do Rio Grande do Sul; 2008.
[b]Oliveira TCG, Soares FC, Macedo LDD, Wanderley DL, Diniz P, Bento-Torres NVO, Picanço-Diniz CW. Beneficial effects of multisensory and cognitive stimulation on age-related cognitive decline in long-term-care institutions. Clinical Interventions in Aging, 2014;14(9): 309-321.
[b]Paulo DLV, Yassuda MS. Elderly individuals with diabetes: adding cognitive training to psychoeducational intervention. Educational Gerontology, 2012; *38*(4): 257-270.
[b]Santos IB. Oficinas de estimulação cognitiva em idosos analfabetos e com transtorno cognitivo leve (Dissertação). Brasília (DF): Programa de Pós-Graduação em Gerontologia, Universidade Católica de Brasília; 2010
Silva HS, Yassuda MS. Memory Training for older adults with low education: mental images versus categorization. Educational Gerontology, 2009; *35*(10): 890-905.
[b]Teixeira-Fabrício A, Lima-Silva TB, Kissaki PT, Vieira MG, Ordonez TN, Oliveira TB, et al. Treino cognitivo em adultos maduros e idosos: impacto de estratégias segundo faixas de escolaridade. Psico-USF, 2012; 17(1): 85-95.
[a,b]Yassuda MS, Batistoni SST, Fortes AG, Neri AL. Treino de memória no idoso saudável: benefícios e mecanismos. Psicologia: Reflexão e Crítica, 2006; 19(3): 470-481.
[b]Zimmermann N, Netto TM, Amodeo MT, Ska B, Fonseca RP. Working memory training and poetry-based stimulation programs: are the differences in cognitive outcomes in healthy older adults? NeuroRehabilitation, 2014; 35(1): 159—170.
[a,b]Wood GMO. Efeitos do nível de auto-eficácia cognitiva percebida e de programas de treinamento cognitivo sobre a capacidade de memória de trabalho de indivíduos idosos (dissertação). Belo Horizonte: Programa de Pós-Graduação em Psicologia, Universidade Federal de Minas Gerais; 2000.

a=study reported training protocol construction procedures; b=study outlined the cognitive tasks used during the training.

This late start in comparison to international studies has led to a smaller accumulation of evidence concerning the effectiveness of Brazilian interventions and consequently, a reduced number of standardized intervention protocols. In addition, the dissemination of intervention design procedures and the descriptions of the cognitive tasks used in training has sometimes been neglected. Of the 21 national studies analyzed, only five (23%) provided the design procedures of the cognitive tasks and the strategies used or indicated the source of the protocol when using protocols created by other authors. Concerning the specifications of the tasks, 14 (66%) studies provided adequate details of the cognitive tasks and mnemonic strategies used in the intervention (Chart 1).

The aim of the present study was to present the development procedures of a cognitive training protocol for elderly individuals that was designed for a Brazilian context, as well as to describe the intervention tasks and strategies used. This research also reported the preliminary results of a training protocol that was tested in a pilot study.

METHOD

Development of the Cognitive Training Protocol

Concerning the task training development procedures, we first opted to create an original protocol for Brazil, rather than using a protocol that had been created by other authors. This decision was motivated by the absence (in both national and international literature) of multi-modal training models for elderly individuals of the "pencil and paper" variety. The idea was that these protocols would be adequately disseminated or made available with instructions related to the application and stimuli, as well as the recordings of the performance of the participant.

The first stage consisted of a review of national and international studies addressing cognitive interventions for the elderly, with a particular focus on randomized clinical trials, meta-analysis studies and systematic reviews, in order to define the choices to be made in relation to structural aspects of an intervention. This first stage resulted in the adoption of the following protocol format and structure:

a) Individual *versus* collective modality: we opted to conduct individual training sessions given that most of the relevant Brazilian studies have proposed collective interventions.[39-41] Thus, there is a lack of evidence available related to individual training, which makes it difficult to compare the two modalities. Despite the common argument in Brazilian literature that collective training increases the motivation and adherence of the participants,[23] it is not possible to delineate an intervention that is adapted to the level of the individual's abilities during collective training sessions.

b) Multi-domain *versus* unimodal intervention: we opted to create an intervention focusing on multiple abilities, with a wide variety of tasks, due to the results of earlier studies, which suggested that multi-domain training is more effective.[42,43] Conversely, a meta-analysis study reported a greater effect size after an intervention that only trained processing speed, when compared with multi-domain training.[34] In the present study, the training was developed to focus on the following abilities: focused attention; processing speed; episodic memory and working memory.

c) Mnemonic strategies: for the sessions involving the training of episodic memory, compensatory strategies were generally used due to their greater adequacy for the target public of the research.[12] These strategies included mental visualization, name-face association and idea association. One strategy classified as restorative (spaced recovery) was included in memory training as it was more suitable to storytelling memory activities.[12]

d) Attention training: it was decided that attention exercises would be included before memory training, based on findings that suggest better results in memory training when it is preceded by attention training (pre-training).[44]

e) "Pencil and paper" format *versus* computerized format: the present study used a “pencil and paper” format rather than a

computerized format as the latter can cause intervening variables, due to the difficulties the individuals have with computerized technology.

f) Adapted format: we decided to use an intervention format that was adapted in two ways: 1. the level of performance of the participant: the completion of the protocol tasks was conditioned to the cognitive performance of the participants in order to avoid tiredness and frustration, which may have occurred if they were asked to perform tasks that were beyond their level of ability; 2. daily activities: a number of episodic memory tasks were elaborated in such a way as to apply the strategies learned in daily individual situations.

After the definition of the structural aspects of the protocol, the general intervention criteria were stipulated. These were applied by the examiner during the performance of the tasks. These guidelines were established in order to standardize the application of the intervention using specific instructions to improve the participant's performance during the task. Three guidelines were created for the coordination of the tasks:

- Levels of difficulty: the items were organized using three levels of difficulty (easy, medium and difficult). Each level of difficulty contained approximately three items.
- Interruption criteria: interruption criteria were created for the participant in relation to the three levels of difficulty, thereby providing the program with a format of applicability that was adapted to the performance of the participant. This adaptation was created in order to assuage the effects of tiredness among the participants and to increase their motivation and adherence to the program.
- Number of attempts: most of the tasks involved items classified as "second attempt" or "second stimulation". This set of items is preceded by a set of interventions (instructions/ tips and/or cognitive strategies) that sought to improve the performance of the individuals in the task in question.

Finally, a set of tasks was created for each target-ability of the training protocol, which was applied over 12 sessions. Chart 2 displays the tasks used in each cognitive domain trained, as well as a description and the specification of the number of items involved.

Chart 2. Description of the cognitive training tasks per session. Vitória da Conquista, Bahia, 2014.

Session 01			
Cognitive domains	Tasks	Description	No. of items
Concentrated attention and processing speed	Explaining attention	Information about what is attention, how this ability affects our routine and how we could improve it.	
	Game of seven errors	Identify differences between two figures;	7 items
	Mazes	Draw the correct path through a maze, without crossing over the lines, in a controlled time period; Repeat the same maze in half the time required to complete it the first time.	Easy – 3 items Medium – 3 items Difficult – 3 items

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Continuation of Chart 2

Session 02			
Cognitive domains	Tasks	Description	No. of items
Memorizing visual stimuli	Figures	Analyze a figure and reproduce it while looking at it; Analyze a figure and reproduce it without seeing it anymore.	Easy – 3 items Medium – 3 items Difficult – 2 items
	Cinema	Watch the short film "Solo" and answer questions about the story and characters	1 item
Session 03			
Cognitive domains	Tasks	Description	No. of items
Attention for auditory stimuli and episodic memory	Sound stimulation	Identify, in a set of several words, the one that is wrong or does not exist.	10 items
	Retelling stories	Listen carefully to a story, divide it into segments; retell the story partly; retell the story in its entirety.	Easy – 3 items Medium – 3 items Difficult – 3 items
Session 04			
Cognitive domains	Tasks	Description	No. of items
Concentrated attention and processing speed	Visual search	Mark the stimulus-target within a series of distractor stimuli, with controlled time; repeat the task in half the time required for the first attempt.	Easy – 3 items Medium – 3 items Difficult – 3 items
	Film	Discussion of the short film "Dona Cristina lost her memory".	1 item
Session 05			
Cognitive domains	Tasks	Description	No. of items
Episodic memory (strategy of mental visualization)	Visualization	Close your eyes and describe the room around you; look at the image of a house and when the image is no longer present, describe it.	2 items
	Photography	Analyze personal photographs and once they are no longer visible, describe them and answer questions about them.	2 items
	Parts of the body	Imagine that each part of the body is transformed into a different object.	6 items
	Visualizing figures	Analyze figures and once they are gone, visualize them in your mind to answer questions about them	3 items

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Continuation of Chart 2

Session 06			
Cognitive domains	Tasks	Description	No. of items
Episodic memory (strategy of idea association)	Idea association	Make associations to memorize tasks	3 items
	Implementing future actions	Imagine you are performing future actions	1 item
	Medicine	Make associations to memorize drugs	Variable in accordance with the number of drugs per participant
	Commitments	Make associations to memorize commitments	Variable in accordance with the number of commitments per participant
Session 07			
Cognitive domains	Tasks	Description	No. of items
Episodic memory	Memorizing names	Create different strategies to memorize the names of people	11 items
Session 08			
Episodic memory	Tasks	Description	No. of items
	Memorizing numbers	Create different strategies to memorize numbers	3 items
	Important numbers	Create different strategies to memorize important personal numbers	Variable in accordance with the number of important numbers per participant
Session 09			
Episodic memory	Tasks	Description	No. of items
	Commemorative dates	Create different strategies to memorize important dates	Variable in accordance with the number of commemorative dates per participant

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Continuation of Chart 2

Session 10			
Cognitive domains	Tasks	Description	No. of items
Working memory	Phonological domino	The instructor says a word and the participant should state a name that begins with the same syllable as the last syllable said by the instructor	10 items
	Pa-pa-ra-pa-Pá	Count the number of stimuli-targets in a set of distractor stimuli, while intoning a rhythm at the same time	3 items
Session 11			
Cognitive domains	Tasks	Description	No. of items
Working memory	Sequence of stories	Read disorganized sections of a story to later retell it in the correct order, without help from the stimuli	4 items
	Rescuing stories	The participant received blank cards and each one represents a significant event in a decade of life. At the end, they organize the material in chronological order.	1 item
Session 12			
Cognitive domains	Tasks	Description	No. of items
Working memory	Months	The participant should repeat a sequence of months, following the order of the calendar	Easy – 4 items Medium – 4 items Difficult – 4 items
	Number of letters	Saying the number of letters in a word, without printed stimuli	Easy – 5 items Medium – 5 items Difficult – 5 items

The training program material consisted of three manuals for individual use: 1) the stimuli manual, which contained all of the stimuli presented to the participant; 2) the protocol of records, which was used to record the participant's performance in all of the tasks; 3) and the instruction manual, which contained the material created by the examiners and detailed instructions about the application procedures for each session.

The stimuli used to apply the tasks, as well as the application instructions and the method of recording responses, can be seen in the work by Santos.[45] Once finalized, the training protocol consisted of 12 sessions of thirty minutes, which were conducted on a weekly basis using the individual modality application.

Pilot study

A pilot study was conducted to ascertain what improvements and corrections were required for the training protocol, as well as: 1) to determine the effects of the training protocol on the mental performance of elderly individuals; 2) to determine the adequacy of the language used in the instructions for the tasks (how well they were understood); and 3) to determine the feasibility of the session planning in relation to the number of tasks stipulated.

Participants

In total, 15 elderly individuals took part in the present study. The following exclusion criteria were applied: a) a severe cognitive deficit reported in the anamnesis interview; b) symptoms of depression: a geriatric depression scale (GDS-15) score of >5, in accordance with the criteria of the Brazilian sample;[46] c) a diagnosis of dementia; d) a severe visual and/or auditory deficit that would have a negative effect on communication. After the screening, the participants of the final sample (N=15; mean age =73.13, SD=3.37; mean years of education =4.33, SD=2.44), who were all female, were divided into two groups: the experimental group (EG) received the training; the control group (CG) did not receive training but participated in dynamic and psycho-affective meetings. The division was conducted in a non-random manner based on convenience, given that the control group was formed by members of a care center for the elderly. The experimental group (EG) contained seven participants (n=7), who were aged between 70 and 82 years (M=73.57, SD=4.11) and had a mean education of 5.8 years (SD=1.02). The control group (CG) contained eight participants (n=8), who were aged between 69 and 77 years (M=74.00, SD=4.58) and had a mean education of 2.88 years (SD=2.58).

Instruments

The following instruments were used to screen the participants:

- Anamnesis interview: created especially for the present study, the interview addressed the current and past clinical health condition of the participants, the presence of emotional and cognitive symptoms, psychiatric disorders and senile dementia.
- Geriatric depression scale:[46,47] the aim of this scale is to identify and quantify depressive symptoms in the elderly population. The reduced version (15 items) was used for the present study, in accordance with the criteria for a Brazilian sample. Participants with a score above 5 on the scale were excluded.
- Mini mental state examination:[48,49] this short 30-point questionnaire was used to track cognitive losses and the estimate the severity of dementia. It contains questions and simple problems related to several issues: orientation in time and space; short-term memory; arithmetic; language comprehension and basic motor skills.

Cognitive measurements before and after training

In order to assess the cognitive performance before and after the training, five subtests of the Wechsler Adult Intelligence Scale (WAIS-III) were used:[50] figures; codes; arithmetic; matrix reasoning and digits. The instruments were applied individually in a single session, with an interval of 15 minutes, or in two sessions, depending on the availability and level of tiredness of the participants.

Instruments to assess the structural aspects of the training

In order to understand the level of understanding of the participants, a brief interview was conducted with each member of the EG. To determine the feasibility of the format proposed in the sessions, the examiners applied an open questionnaire that assessed the quality of the stimuli, the recording of the responses and the application instructions.

Procedures

After the construction of the cognitive training protocol and the elaboration of the tasks, elderly individuals were invited to participate in the study based on the recruitment process. The research project was explained to them and those who agreed to participate signed a free and informed consent form. A group of six psychology students were trained to conduct the intervention and apply the cognitive tests. The monitors were trained for three months under the careful guidance of one of the researchers responsible for this project, who also supervised the application of the activities.

Since the interventions were conducted individually, the number of sessions varied in accordance with the individual performance of the participants (due to their speed while performing the tasks and the application of the interruption criteria). This is not typical of collective modality training studies, in which all of the participants follow the same pace in a fixed number of meetings. In the pilot study, the examiners were instructed to interrupt the session if they noticed signs of tiredness and to anticipate tasks that were planned for a later meeting if the participant was performing very well. Thus, the program is adaptive: a number of tasks in the domain "episodic memory" worked with the daily activities of the participants, including taking medicine, commitments, dates and important numbers, thereby preventing the standardization of the application time. These factors resulted in a variable number of sessions, since some participants finished the training protocol in only nine sessions (of the 12 planned sessions), whereas other participants needed 13 sessions to complete it.

The cognitive measurements were applied before (pre-training) and immediately after (post-training) training in the individual modality. At the end of the study, each participant was interviewed (individually) once again and received a written report outlining their performance. The interview involving the participants of the EG (to determine the adequacy of the language used in the instructions) was always performed at the end of each session. The questionnaire that was used by the examiners to assess aspects of the feasibility of the protocol was applied at the end of the intervention.

The present study received approval from the Research Ethics Committee of the Universidade Federal de Minas Gerais (Federal University of Minas Gerais) under protocol number (CAAE: 30885414.8.0000.5149) and satisfied all ethical standards and demands.

Data analysis

Initially, descriptive statistics were used with the weighted scores to calculate the mean and standard deviation values for the pre- and post-test scores in the EG and the CG. The differences between the two groups in the pre-test scores were then analyzed using the Mann-Whitney test. Subsequently, the Shapiro-Wilk normality test was computed for the subtest scores of the WAIS-III. This test is appropriate for samples with less than 100 participants and tests the hypothesis that the sample is from a population with normal distribution. For the subtests that refuted the null hypothesis of the Shapiro-Wilk test (p-value greater than 0.05), ANOVA for repeated measurements was conducted. Rank transformation ANOVA[51], a non-parametric test to assess repeated measurements, was carried out for the subtests that exhibited significance in the Shapiro-Wilk test. The effect size was calculated using the eta generalized squared test.[52] All of the analysis was conducted using free R software. The interviews conducted with the participants of the EG and the protocol assessment questionnaire (completed by the examiners) were analyzed qualitatively.

RESULTS

The descriptive statistics were calculated using the weighted scores of the WAIS-III subtests, as per the age group tables for the Brazilian sample.[50] Table 1 displays the mean and standard deviation values for each measurement, separated by group. In general, the results indicate an increase or stabilization for all of the post-training scores in the EG, whereas the participants in the CG exhibited stable or declining scores after the intervention.

Table 1. Descriptive statistics for the EG and CG. Vitória da Conquista, Bahia, 2014.

	Experimental Group				Control Group			
Subtest	Pre-test		Post-test		Pre-test		Post-test	
Figures	M	SD	M	SD	M	SD	M	SD
	12.14	3.07	15.86	1.77	9.25	1.98	8.88	1.88
Codes	M	SD	M	SD	M	SD	M	SD
	8.86	1.46	10.86	3.02	7.00	1.06	6.75	1.48
Arithmetic	M	SD	M	SD	M	SD	M	SD
	9.29	3.09	10.29	3.25	4.75	1.90	3.88	1.24
Matrix reasoning	M	SD	M	SD	M	SD	M	SD
	10.71	2.98	13.43	4.07	7.88	1.45	7.50	1,06
Digits (total)	M	SD	M	SD	M	SD	M	SD
	10.57	3.04	13.00	3.41	8.71	2.21	8.13	1.35

It was also found that the individuals in the CG performed worse in the pre-test than the individuals in the EG, which was expected due to the lower level of education of the individuals in the CG. The Mann-Whitney test was used to determine the statistical significance of the difference in performance between the two groups in the pre-test, with the following results: codes ($U=48$, $p=0.02$), arithmetic ($U=52{,}5$, $p=0.005$) and matrix reasoning ($U=49$, $p=0.01$). No significant differences were found between the groups for figures ($U=43{,}5$, $p=0.08$) or digits ($U=34$, $p=0.24$).

The Shapiro-Wilk normality test was used to determine the normality of the data distribution. Normal distribution was confirmed for all of the measurements except matrix reasoning ($W=0.80$, $p=0.004$). Therefore, ANOVA for repeated measurements was conducted for the subtest figures, codes, arithmetic and digits, whereas rank transformation ANOVA was conducted for matrix reasoning.

The results of the ANOVA for repeated measurements confirmed a significant interaction effect between the time versus group factors for figures [$F(1)=8.01$; $p=0.01$, $\eta^2_G=0.19$], indicating a significant increase in performance among the participants in the EG between the pre- and post-tests, when compared with the participants in the CG. A significant interaction effect was also recorded between the time versus group factors for the subtest codes [$F(1)=5.40$, $p=0.03$, $\eta^2_G=0.09$], indicating a significant increase in performance among the participants in the EG between the pre- and post-tests. There was also a significant effect for the isolated group factor [$F(1)=12.60$, $p=0.003$, $\eta^2_G=0.42$], indicating differences between the groups regardless of the period of the study. For the subtest arithmetic, a significant interaction was found between the time versus group factors [$F(1)=9.03$; $p=0.01$, $\eta^2_G=0.004$], indicating that there was a significant improvement in the performance of the participants in the EG, when compared to those in the CG. There was also a significant effect for the isolated group factor [$F(1)=1.96$, $p<0.001$, $\eta^2_G=5.87$], indicating differences between the groups regardless of the period of the study. No time versus group interaction effect was recorded for digits, although there was a significant result for the isolated group factor [$F(1)=10.04$, $p<0.001$], confirming significant differences between the groups regardless of the period of the study. The

subtest matrix reasoning exhibited an abnormal distribution. Consequently, rank transformation ANOVA, which is a non-parametric test for repeated measurements, was carried out. The result did not indicate a significant time versus group interaction effect [$F(1)=1.43$, $p=0.25$] for this measurement.

After analyzing the questionnaires (completed by the participants of the EG and the examiners) used to assess the structural aspects of the program, the following modifications were made to the protocol: 1) the seven errors game was removed: the participants found this task to be childish and the examiners thought it burdened the session unnecessarily, given the low cognitive effort that it required; 2) the cinema and film exercises were considered excessive by the examiners. However, the participants found them to be motivating and as such, they were classified as optional; 3) the participants resisted the copies exercise as it demanded drawings and the examiners found the task to be too extensive. The number of items was reduced and the task instructions were improved in an attempt to achieve greater adherence; 4) the teaching instructions for the mnemonic strategy "idea association" were reformulated, as the participants had found them confusing.

DISCUSSION

In recent decades, the field of cognitive intervention has made significant advances in relation to the development of techniques, strategies and the format of intervention programs, as well as the methodological aspects of studies.[23,34] However, when comparing the amount of evidence accumulated in international and Brazilian literature, the difference is immense, particularly in relation to the quantity of protocols of training originally developed for the Brazilian population and the number of experimental studies conducted to test the effectiveness of these interventions. In addition to this gap, there is a scarcity of scientific studies that focus on disseminating the design procedures for training protocols, which hinders methodological advances in the area:

1. Modern day cognitive interventions are characterized by the extreme heterogeneity of the training protocols. This phenomenon has been reported in international literature [2] and in Brazilian studies, and includes aspects such as structure, format, the number of sessions, cognitive tasks and the mental strategies taught. This heterogeneity hinders the performance of meta-analysis studies, which are essential if the field is to advance and resolve the divergences related to the hypothesis of cognitive enrichment** and adequate comparison parameters among studies for the subsequent analysis. One of the greatest challenges reported in meta-analysis studies is obtaining the comparison parameters required for such a heterogeneous range of interventions. [23,34,36]

2. The poor availability of the protocols used in experimental studies, detailing the tasks, stimuli and instructions, damages the principle of scientific reproducibility, thereby hindering or even preventing a training protocol from being extensively assessed by other researchers in different contexts.

3. Finally, the lack of Brazilian studies reporting the creation procedures of training protocols prevents the field from advancing and achieving a gold standard, with guidelines for the development of cognitive interventions.

Analysis of 21 Brazilian studies in the field confirmed that only five (23%) reported the development procedures of the intervention used or provided the sources when protocols developed by other authors were used. It is important to stress, however, that none of the studies in this small group set out to share the stages of development of the intervention. In addition, little over half of the studies (61%) disseminated the tasks used in the training with an adequate level of specificity. Based on these issues, the present study shared the stages and procedures involved in the development

** The hypothesis of cognitive enrichment addresses the possibility of promoting a stable alteration in the cognitive structure of elderly individuals. For more information, see Hertzgov et al (2009) and Salthouse (2006).

of a cognitive training protocol and reported the preliminary results of its impact on the mental performance of the elderly individuals in question.

Different cognitive tasks were elaborated, with a focus on stimulating and teaching strategies of concentrated attention, processing speed, episodic memory and working memory. The tasks were split into 12 sessions of individual training, which were conducted on a weekly basis and lasted one hour and thirty minutes each. Three manuals were created for the training process: 1) an instruction manual, for the use of the monitor; 2) a stimuli manual, containing all of the stimuli presented to the participant; and 3) a records manual, which was used to record the answers and performance of the participants during the meetings.

The protocol was tested on a group of 15 elderly individuals, who were divided into an experimental group (who received the training) and a control group (no intervention). Of the five cognitive measurements used, the ANOVA test confirmed an effect of the training for three subtests: training gain effects were observed immediately after the intervention for attention and processing speed tasks related to codes [$F(1)=5.40$, $p=0.03$, $\eta^2_G=0.09$]; for mental calculations and working memory, assessed by the subtest arithmetic [$F(1)=9.03$; $p=0.01$, $\eta^2_G=0.004$]; and for the ability to categorize and identify essential and non-essential details in the figures subtest [$F(1)=8.01$; $p=0.01$, $\eta^2_G=0.19$]. No gain effects were observed for matrix reasoning [$F(1)=1.43$, $p=0.25$] or digits [$F(1)=10.04$, $p<0.001$]. The qualitative results led to significant modifications to the training protocol, in order to improve it for subsequent studies.

Concerning the similarities between the results of the present study and those found in international literature, consonance was observed with the results of the longitudinal project known as ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly),[11,30] which reported an increase in cognitive performance immediately after training among participants who received training for attention and processing speed. Conversely, intervention effects were obtained for episodic memory and reasoning tasks. More recently, a meta-analysis study of ten clinical trials of elderly individuals[34] reported a significant effect size, with the following measurements: 0.22 for processing speed (Cohen d); 0.16 for reasoning training; 0.15 for multimodal training and; (a weaker effect) 0.12 for memory training. In 2011, a systematic review of 14 intervention programs for healthy elderly individuals[35] found that the interventions were effective and led to significant improvements in attention and processing speed.

Irigaray et al. conducted attention and memory training and reported intervention effects in the experimental group for certain cognitive measurements, including the measurements of working memory and verbal memory (recognition). Similar to the present study, which confirmed training effects for the attention measurement, Brum also found a significant effect for two attention measurements, one of which was for the subtest codes. Conversely, Chariglione (2013) reported a significant improvement in the experimental group for episodic memory measurements, which was not the case in the present study.

However, it is important to highlight two limitations when comparing the results of the present study with those reported in other studies: 1) the results reported herein are restricted and do not favor conclusions about the effectiveness of the training on the cognitive gain of the elderly participants, considering the non-randomization of their distribution and the size of the sample. There were also differences between the EG and the CG that limited comparisons between them; 2) as previously reported in international meta-analysis studies, different types of training and different cognitive measurements limit comparisons between studies, since each study has a unique structure and number of sessions, using different strategies and cognitive measurements to determine the effects.

CONCLUSION

The present study was successful in terms of fulfilling its aim of creating a protocol of cognitive training for the elderly, with the systemization of mental exercises and cognitive strategies in printed material and the possibility of recording the performance of the participant in a separate protocol. Notably, the individuals in the experimental group performed better in three of the five cognitive measurements after the intervention. However, these results do not allow us to conclude that the training had a significant effect. There may be a need to conduct a randomized clinical trial to adequately test the effects of the program. The present study contained a number of limitations related to the creation phase of the training protocol: the absence of analysis performed by judges, in which the tasks could have been judged by specialists in terms of their level of representativeness of the relevant cognitive abilities. This is common in content validity studies in the field of measurements. In the present study, it was possible to investigate the sources of evidence of content validity through the assessment of structural aspects of the training (by participants and examiners). Concerning the pilot study and the aim of determining the impact of the training on the mental performance of the elderly individuals, the different performance levels recorded in the pre-test (between the EG and the CG) for the subtests codes, arithmetic and matrix reasoning, as well as the different education levels found between the two groups, represent limitations. For future research, the authors intend to develop the following studies: 1) a clinical randomized trial with an experimental design to increase the power of inference on the effects of the cognitive training developed; 2) a study of structural validity, to analyze the performance of the sample in training tasks and to ascertain if the factorial structure subjacent to the protocol corroborates its theoretical model (concentrated attention, processing speed, episodic memory and working memory).

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