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COGNITIVE TRAINING IN THE ELDERLY AND ITS EFFECT ON THE EXECUTIVE FUNCTIONS

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Abstract

Aging is commonly associated to cognitive decline and loss of other abilities, which leads to the need of researching elements that may contribute to preventive cognitive rehabilitation interventions aiming to guarantee the elderly quality of life. The objective of this study is to characterize elderly who enrolled in this intervention, to measure the effects of cognitive training with emphasis on executive functions, by comparing an Experimental to a Control group. This is a quantitative research that used a quasi-experimental design; it is correlational and comparative, involving pre- and post-testing and intervention. The sample was formed by 83 elders, split into an Experimental Group (EG) (45 people) and a Control Group (GC) (38 people). The instruments used were the following: a neuropsychological semi-structured interview about sociodemographic characteristics; Mini Mental State Examination (MMSE); Beck Anxiety Inventory (BAI); Geriatric Depression Scale (GDS); WAIS-III subtests: Digit Span, Vocabulary, Block Design, Coding, Letter-Number Sequencing (LNS), and Symbol Search; Trail Making Test (TMT); Ray Complex Figures; Sternberg Paradigm; verbal fluency tasks about semantics (animals) and phonemes (F-A-S); Rey Auditory-Verbal Learning Test (RVLT); Stroop Test: colors and words; go/no go tasks; and the Wisconsin Card Sorting Test (WCST). The results from the comparison between groups showed that there was a significant difference regarding the number of errors in the Sternberg Paradigm and Completed Categories of the WCST. Intragroup comparisons showed that the EG had better results after the intervention on the following tests: GDS, RAVLT, Rey Complex Figures (memory), Digit Span and Vocabulary.
Key words: Cognitive training, executive functions, elderly, neuropsychology, aging.

EL ENTRENAMIENTO COGNITIVO EN LOS ANCIANOS Y EFECTOS EN LAS FUNCIONES EJECUTIVAS

Resumen

El envejecimiento se asocia comúnmente con el deterioro cognitivo y la pérdida de otras capacidades, lo cual conlleva la necesidad de investigar elementos que puedan contribuir a las intervenciones preventivas de rehabilitación cognitiva y que tienen como objetivo garantizar la calidad de vida de los ancianos. El objetivo de este estudio fue caracterizar ancianos que se inscribieron en esta intervención, para medir los efectos del entrenamiento cognitivo, con énfasis en las funciones ejecutivas, comparando un grupo experimental con un grupo control. Se trata de una investigación cuantitativa, con un diseño cuasi-experimental; es correlacional y comparativa, con pre y post-test e intervención. La muestra estuvo conformada por 83 ancianos, dividida en un grupo experimental (GE) (45 personas) y un grupo control (GC) (38 personas). Se utilizaron los siguientes instrumentos: entrevista neuropsicológica semiestructurada sobre características sociodemográficas; Examen Mínimo del Estado Mental (Mini Mental State o MMSE, por sus siglas en inglés); Inventario de Ansiedad Beck (BAI, por sus siglas en inglés); Escala de Depresión Geriátrica (GDS, por sus siglas en inglés); subpruebas WAIS-III: prueba de amplitud de dígitos (Digit Span), Vocabulario, diseño con bloques, codificación, Secuenciación de Letras y Números (LNS por sus siglas en inglés), y la búsqueda de símbolos; Test de Trazos (TMT por sus siglas en inglés); Figuras Complejas de Rey; Paradigma

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de Sternberg; tareas de fluidez verbal sobre semántica (animales) y fonemas (F-A-S); Prueba de Aprendizaje Verbal-auditiva Rey (RVLT por sus siglas en inglés); Prueba de Stroop: colores y palabras; tareas ir/no ir; y Test Wisconsin de Clasificación de Cartas (WCST por sus siglas en inglés). Los resultados de la comparación entre los grupos mostraron que hubo una diferencia significativa en cuanto al número de errores en el Paradigma de Sternberg y las categorías completas del WCST. Las comparaciones intragrupales mostraron que el GE tuvo mejores resultados después de la intervención en las siguientes pruebas: GDS, RAVLT, Figuras Complejas de Rey (memoria), prueba de amplitud de dígitos y vocabulario.
Palabras clave: Entrenamiento cognitivo, funciones ejecutivas, personas de edad avanzada, neuropsicología, envejecimiento.

TREINO COGNITIVO EM IDOSOS E EFEITOS NAS FUNÇÕES EXECUTIVAS

Resumo

O envelhecimento está comumente relacionado ao declínio cognitivo e a outras perdas de diferentes habilidades, o que aponta a necessidade de buscar elementos que possam contribuir para intervenções preventivas de reabilitação cognitiva, que tenham como objetivo assegurar uma melhor qualidade de vida do idoso. O objetivo deste estudo é caracterizar os idosos participantes, mensurar os efeitos do treino cognitivo, com ênfase nas funções executivas, comparados a um grupo controle. Trata-se de uma pesquisa do tipo quantitativa, com delineamento quase experimental, correlacional e comparativa com pré e pós-teste e de intervenção. Houve grupo controle para comparação. A mostra foi composta por 83 idosos da população geral, divididos em 45 idosos que fizeram parte do Grupo Experimental (GE) e 38 idosos participantes do Grupo Controle (GC). Instrumentos utilizados: Entrevista neuropsicológica sociodemográfica; Mini Exame do Estado Mental (MEEM); Inventário de Ansiedade de Beck (BAI); Escala de Depressão Geriátrica (GDS); Subtestes Dígitos, Vocabulário, Cubos, Código, Sequência Números e Letras (SNL); Procurar Símbolos (WAIS-III) ; Trail Makint Test (TMT); Figuras Complexas de Rey; Paradigma de Sternberg; Tarefas de fluência verbal (letras F, A, S); Rey Auditory-Verbal Learning Test (RVLT); Teste Stroop; Tarefas go-no-go e Teste Wisconsin (WCST). Os resultados mostraram na comparação entre os grupos, que houve diferença significativa quanto à variação no número de erros no Paradigma de Sternberg, Categorias Completadas do WCST e Procurar Símbolos. Nas comparações intragrupo, o Grupo Experimental melhorou significativamente os escores após a intervenção dos instrumentos GDS, RAVLT, Figuras Complexas de Rey–memória, Dígitos OD, Dígitos Total e Vocabulário.
Palavras-Chave: Treino, funções executivas, idosos, Neuropsicologia, memória, envelhecimento.

INTRODUCTION

Cognitive aging represents an individual and social health problem. The loss of cognitive abilities is usually viewed as an inevitable consequence of the aging process. However, the structural and cognitive process of natural aging is not described in the literature (Grieve, Williams, Paul, Clark & Gordon, 2007). Important studies show that some cognitive abilities decline with age even in people without other diseases, while other areas are preserved (Mayr, Spieler & Kliegl, 2001).

Aging is commonly related to cognitive decline. The loss of several abilities tends to occur, such as attention, memory, and executive function. It is necessary to carry out research about elements that may contribute to preventive interventions in cognitive rehabilitation, aiming to preserve the quality of life of elderly people (Nascimento, Argimon & Lopes, 2006).

Furthermore, certain abilities dependent on the frontal lobe, such as Executive Functions (EF), working memory and psychomotor speed, are the most affected by the aging process (Evans, 2007; Head, Kennedy, Rodrigues & Raz, 2009). EF are a heterogeneous group of cognitive processes which include problem solving, organization, planning, verbal reasoning, inhibitory control, and self-monitoring (Tirapu-Ustárroz, Muñoz-Céspedes, Pelegrin-Valero & Albéniz-Ferreras, 2005; Tirapu-Ustrárroz & Muñoz-Céspedes, 2005; Tirapu-Ustrárroz, Lago, & Unturbe, 2011).

EF were initially defined, nonspecifically, by Luria (1964); they were not called executive functions, but he concluded that the frontal lobe plays an essential part in motivation, initiative, planning, goals and actions, and self-control. Lesak (1987) was the first to use the term "Executive Functions" when mentioning mental capacities that are fundamental for efficient and socially adjusted behaviors. Later, Sholberg and Mateer (1989) stated that the EF encompass a series of executive components, such as anticipation, choosing goals, planning, behavior selection, self-control, and feedback. Matter, mentioned by Tirapu-Ustárroz (2011), says that attention, priority recognition, intentionality, planning and executing goals, and recognizing achievements are components of the EF. The integrated approach defended by Tirapu-Ustárroz (2011) defines the EF as the capacity to cope with a new problem, predicting its consequences. EF are based on the prefrontal cortex and allow the brain to create actions, simulate situations, and

assess how appropriate the solutions and behaviors are, according to the demands. Thus, this study selected the following components, which are part of the EF (Tirapú-Ustárroz, 2011).

Estimated Cognitive Ability

The evaluation of this construct was done using the subtests Vocabulary and Block Design of the WAIS-III test, because they present high rates of reliability and correlations with the global score, and are an appropriate way to evaluate intelligence, especially the *g* factor (Sattler, 1988). It has been used for estimating the elderly intelligence in health centers. Besides, these subtests are considered the most resistant for evaluating pre-morbid intelligence (Alves, Simões, & Martins, 2014; Lezak et al., 2012).

Alternating Attention

It refers to the ability for quickly shifting the attention from one task to another. It requires flexibility in directing attention, and the ability for switching the task (Tirapu-Ustárroz & Céspedes, 2005). Attention is considered a specific example of EF. It can be classified into separate functions, including divided attention, alternating attention, selective attention, sustained attention, and focused attention – but these distinctions are, in a way, artificial. Divided attention refers to the ability for performing more than one task at a time, and alternating attention refers to quickly shifting the focus from one task to another. Selective attention allows filtering information stimuli. Sustained attention refers to the ability to maintain the focus on one task for a period of time (Lezak, 1995-2005; Rogers, 2006). Hence, attention can be considered an anatomic network with the purpose of influencing the functioning of other brain networks (Posner, Sheese, Odludas, & Tang, 2006).

Processing speed

It is associated with the ability to fluently perform tasks that are easy or have already been learned. It refers to the ability for processing information automatically.

Working Memory (updating)

It works as a filter for new information and relevance for the task in progress, which later updates the information content and replaces old irrelevant information by new and relevant ones. Seven pairs of random number sequences were read aloud by an advisor, one number per second. The subtest Digit Span in direct order (DO) and indirect order (IO) were used (Wechsler, 2004). The difference between the scores from the DO and IO tests were used as an index of the central executive component of the working memory. Thus, a smaller difference between scores indicates a better working memory (Davis, Marra, Najafzadeh, & Liu-Ambrose, 2010).

Phonological loop

This is a short-term phonological storage based on an articulatory rehearsal that allows the use of subvocal language for maintaining information during the desired time. The phonological loop is related to a transitory verbal storage system, language acquisition, vocabulary and syntax, and language comprehension (Tirapu-Ustrárroz, Lago, & Unturbe, 2011).

Coding/maintenance

It is related to information coding when the slave systems are saturated (phonological loop and visuo-spatial scratchpad). It is associated to the working memory, because it sustains data while performing other cognitive tasks simultaneously. According to Tirapu-Ustrárroz, Lago e Unturbe (2011), it is usually measured by the Sternberg Paradigm.

Maintenance/Manipulation

It is essential for the working memory and requires the adaptation of other processes. It is hard to study it in an isolated way, since the modification answers from the networks it sustains are rare. It retains and manipulates information.

Response Inhibition, Control of Automatism Interference, Modulation

Inhibition is related to the ability for inhibiting stimuli that are not relevant. It cancels predominantly automatic responses and the ones guided by eminent rewards when they are inappropriate for the situation.

Cognitive Flexibility and Alternation of Cognitive Sets

It is the ability to alternate between different mental schemes and patterns to execute tasks, according to the environment.

Planning and problem solving

This is the ability for anticipating, rehearsing, and executing complex sequences of behaviors, in a prospective plan. The tests require the use of information in a prospective manner during simulation and solving problems that require organizing and behavior sequencing under certain rules.

Table 1.
The main components of the executive functions and their respective tasks.

Functions	Tasks/Tests
Estimated Cognitive Ability	Vocabulary (WAIS-III) Block Design (WAIS-III)
Alternating Attention	Trail Making Test (TMT)–A and B Stroop Test – Colors and Words
Processing Speed	Coding (WAIS-III) Symbol Search (WAIS-III) Stroop Test – Colors and Words Color Trails Test (CTT)–A and B
Executive Processes	
Working Memory Phonological Loop	Digit Span (WAIS-III) Rey Auditory-Verbal Learning Test (RAVLT)
Codification/Maintenance	Sternberg Paradigm
Maintenance/Updating	Digit Span (WAIS-III) Letter-Number Sequencing (LNS) (WAIS-III) Verbal Fluency – F-A-S and Animals
Maintenance/Manipulation	Letter-Number Sequencing (LNS) (WAIS-III) Indirect Order Digit Span
Semantical/Phonological Access Verbal Fluency (Semantic Memory)	F-A-S Test Verbal Fluency – "Animal" category
Response Inhibition, Control of Automatism Interference, Modulation	Stroop Test – Colors and Words Go/No-Go Task
Cognitive Flexibility Alternation of Cognitive Sets	Wisconsin Card Sorting Test (WCST)
Planning and Problem Solving	Rey Complex Figures (RCF)

Note: (Tirapu-Ustárroz*et al*., 2011), adapted.

Neuropsychological Rehabilitation, Cognitive Stimulation and Cognitive Training

Cognitive interventions have many names, concepts, goals, and methods, which can be confusing (Woods, Thorgrimsen, Spector, Royan, & Orrell, 2006). During research, we found the following terms: memory training, memory rehabilitation, reality orientation, cognitive stimulation, neuropsychological rehabilitation, psychosocial rehabilitation, cognitive training, cognitive rehabilitation, and memory stimulation. We also found the terms: compensatory strategies, implicit residual memory, learning without mistakes, and reminiscence therapy. The term cognitive rehabilitation refers to the intervention with patients suffering from brain lesions. It appeared in the end of the 1980s, and it is used in neuropsychology for recuperating lost cognitive functions (Clare & Woods, 2004; Holderbaum, Rinaldi, Brandão, & Parente, 2006). Due to the variety of terms that are used, Clare and Woods (2004) recommend splitting the myriad of techniques into three groups: Neuropsychological Rehabilitation, Cognitive Stimulation, and Cognitive Training.

The term Neuropsychological Rehabilitation (NR) seems to be the most comprehensive, since its techniques encompass psychotherapy, family orientation, therapeutic environment, cognitive rehabilitation, and teaching patients (Prigatano, 1997). NR treats cognitive difficulties and emotional responses in an integrated manner, considering the social context and previous knowledge of the patient (Clare & Woods, 2004). It aims to maintaining cognitive functionality, including motivational, psychological, and social aspects, in which the patients and their relatives participate in the rehabilitation process. This intervention is conducted by multiprofessional teams (Boccardi & Frisoni, 2005). Cognitive Stimulation (CS) is considered the first intervention for diseases like Alzheimer Disease (AD). It collects data by contacting patients suffering from AD and his caretakers, to understand the current situation of the patient. All information is important, and the main

data are obtained with physical contact: voice, gestures, looks, sounds, and objects like figures, calendars or clocks (Moniz-Cook, 2006). Last, Cognitive Training (CT) argues that when one function is exercised, a general improvement is obtained (Farina et al., 2006). This practice uses a set of tasks and simulates daily activities, with the assistance of several resources. These tasks are conducted in a manner in which the patient uses his cognitive functions – such as language, memory, attention–when performing them. The tasks may be performed individually or in groups, at home with family or with assistance from a professional. This training has tasks targeting specific aspects of cognition, such as attention or executive functions, with varied degrees of difficulty. CT can be performed in individual sessions with the help of a therapist and the family, using a computer, or in groups. CT programs can use different intervention procedures to improve cognitive, metacognitive, and affective-motivational aspects of learning. When targeting routine memory specifically, it has proven to improve general cognitive performance (Clare, Woods, Moniz Cook, Orrell, & Spector, 2003).

Many authors have researched CT. Evidence suggests that this intervention is adequate and benefits the healthy elderly as well as those with mild impairments (Belleville, Chetrkow, & Gauthier, 2007; Brum, Forlenza, & Yassuda, 2009; Irigaray, Schneider, & Gomes, 2012). The goals of this study are to characterize the sample of elderly regarding their sociodemographic data, and to measure the effects of cognitive training, with emphasis on executive functions in the elderly.

METHOD

This is a quantitative research, with a quasi-experimental design; correlational and comparative, with pre- and post-testing and intervention. A control group was selected for comparison. The dependent variables are the scores from each test, and the independent variable is the age of the participants. Sampling by convenience was chosen for this study, recruiting elderly who lived in the community and were socially active and independent.

Participants

145 elderly were invited to participate in this study, selected by convenience. All were over 60 years old and lived in the community. 83 elderly agreed to participate in the complete research and formed the Control Group (CG = 38) and the Experimental Group (EG= 45). 16 participants were male (19.3%), and 67 were female (80.73%). Average age for the EG was 69.2 (SD = 6.1), and participants were aged from 60 to 83 years old. Average age for the CG was 68.3 (SD = 6.3), and participants were aged from 60 to 81 years old.

Inclusion criteria

Participants should be at least 60 years old. They had to be capable of hearing and understanding the objectives of this research, not presenting major visual and/or hearing problems that could interfere with the tests. They agreed to participate in the study. They scored at least ≥ 18 points (elderly with low/medium levels of education) or ≥ 26 points (elderly with high levels of education) in the Mini Mental State Examination (MMSE; Bertolucci, Brucki, Campacci, & Juliano, 1994). They scored lower than 5 points in the Geriatric Depression Scale (GDS-15), and lower than 20 points in Beck's Anxiety Inventory (BAI; Cunha, 2001).

Exclusion criteria

Elderly who presented sensory deficiencies that prevented them from hearing or seeing, or a case of dementia and/or an acute confusion state; a motor deficiency or tremor in the dominant hand that prevented them from performing the writing and copying tasks; major diseases and/or other important aspects that could interfere with the research.

Instruments

Mini Mental State Examination (MMSE); Geriatric Depression Scale (GDS); Beck's Anxiety Inventory (BAI); Clock Drawing Test (CDT); Wechsler Adult Intelligence Scale (WAIS-III) – Digit Span, Vocabulary, Block Design, Letter-Number Sequencing (LNS), Coding, Symbol Search; Rey Complex Figures; Trail Making Test (TMT); Sternberg Paradigm; Verbal Fluency tasks: semantics (animals) and phonemic (F-A-S); Rey Auditory-Verbal Learning Test (RVLT); Stroop Test (Colors and Words); Go/No-Go tasks; Wisconsin Card Sorting Test (WCST). The description of these instruments can be found below.

Sociodemographic questionnaires. Sociodemographic data included age, marital status, education, income, gender, leisure activities, and others. This form is usually used in research to describe sociodemographic aspects.

Mini Mental State Examination (MMSE). Developed by Folstein, Folstein, and McHugh (1975), and validated in Brazil by Bertolucci et al. (1994). MMSE scores vary from zero to 30 points, and the established cutoff point is 24. This instrument has been used in epidemiological population studies, and is present in many neuropsychological test batteries (Brucki, 2003).

Beck Anxiety Inventory (BAI). The goal of this test is to measure degrees of anxiety symptoms using a scale of

symptoms. The cutoff points for the psychiatric population, according to the rules of the Brazilian version, researched in 1999 by Cunha (2000), are subdivided in: 0 to 10 = minimum; 11 to 19 = low; 20 to 30 = moderate; 31 to 63 = high (Beck & Steer, 1993; Cunha, 2001).

Geriatric Depression Scale (GDS). The original version of the GDS is composed of 30 dichotomous closed-end questions. In this study, for measuring depression symptoms in the elderly before and after the interventions, we used the GDS-15, validated by Yesavage et al. (1983), which identifies and quantifies depression symptoms in the elderly. We use the test's 15-question Brazilian version in this study because it presents a reliability of 0.81 (Almeida & Almeida, 1999).

Clock Drawing Test (CDT). This test is used to evaluate visuospatial and visuoconstructional abilities and executive functions. It is used in geriatrics, neurology, and psychiatry researches (Aprahamian, Martinelli, Neri & Yassuda, 2010; Shulman, Gold, Cohen, & Zucchero, 1993; Shulman, 2000).

Wechsler Adult Intelligence Scale (WAIS-III; Cunha, 2000; Wechsler, 2004). It is one of the most known and widely used IQ tests, although it is used worldwide in neuropsychological evaluations. These are the functions assessed by each subtest (Cunha, 2000; Kaufman & Kaufman, 2001; Kaufman & Lichtenberger, 1999; Nascimento, 2005; Wechsler, 2004): Coding (Cd) – evaluates attention and immediate memory, learning ability, visual memory, visuomotor coordination, psychomotor speed, ability at imitational tasks, and mental flexibility; Symbol Search (SS) – measures processing speed, psychomotor speed, fluency ability, visuomotor coordination, perceptual organization, speed of mental operations, attention, concentration, short-term visual memory, and cognitive flexibility; Block Design (BD) – measures visuomotor coordination, perception, analysis skill, synthesis, logic reasoning, problem solving strategies, organization, and visual-motor-spatial speed; Digit Span (D) – composed of two different digit tasks, Direct Order (DO) and Indirect Order (IO). According to Cunha (2000), it evaluates the extension of attention, retention of immediate memory (direct order digits), memory, reversibility ability (indirect order digits), and concentration; Vocabulary (V)– this was used because of its high correlation with the sum in the verbal scale, which makes it an adequate measurement of intelligence, with low vulnerability to disorders, and it is considered a possible estimation of pre-morbid intelligence; Letter-Number Sequencing (LNS) – evaluates attention and working memory. The abilities involved in this subtest are working memory, short-term auditory memory, short-term acquisition and recuperation, memory for symbolic stimuli, auditory perception of simple verbal stimuli, sequential processing, and planning skills (Kaufman & Lichtenberger, 1999; Nascimento, 2002).

Sternberg Paradigm. This instrument is commonly used to evaluate the codification and maintenance of information in working memory. The task consists of presenting the subject with a set of three to nine stimuli (i.e.: letters), for five to ten seconds; after that, other stimuli are shown and the participant must recognize the ones he previously saw among the others. Registering and maintaining three letters depends on the phonological loop, but the EF are used for more than three (Tirapu-Ustrárroz, Lago, & Unturbe 2011; Tirapu-Ustárroz, Muñoz-Céspedes, Pelegrin-Valero, & Albéniz-Ferreras, 2005).

Verbal Fluency (F-A-S). This is a task that evaluated Phonological Verbal Fluency by asking the participant to say, in one minute, the highest number of words beginning with the letters "F", "A" and "S". The participant has one minute for each letter. Locations (i.e.: France) and people´s names (i.e.: Frank) are not valid. Studies show that healthy elderly present low performance and elderly suffering from AD present deficits (Bayles & Kasniak, 1987; Monschet al., 1992; Monschet al., 1994; Spreen & Benton, 1977; Strauss, Sherman, & Spreen, 2006).

Verbal Fluency (animal category). Evaluates Semantic Verbal Fluency. The participants must say the largest number of animal names in one minute (Strauss et al., 2006; Spreen & Strauss, 1998). The score depends on the number of animals the participant says (Caramelli, Carthery-Goulart, Porto, Charchat-Fichman, & Nitrini, 2007).

Rey Auditory-Verbal Learning Test (RAVLT). This test measures recent memory, retention of information after other activities, and recognition memory. It evaluates verbal learning and retroactive susceptibility (pro-active and interference) (Diniz, Cruz, Torres, & Consenza, 2000; Malloy-Diniz, Lasmar, Gazinelli, Fuentes, & Salgado, 2007).

Stroop Test – Colors and Words. This test was created to evaluate the participant's ability to generate automatic responses with no interference from habitual stimuli, and to control automatic reflex processes in favor of less habitual stimuli, that is, inhibition. This test was originally developed by Stroop (1935), and many different versions have been developed since then (Strauss et al., 2006; Tirapu-Ustárrozet al., 2005).

Go/No-Go Tasks. These tasks test the inhibition of motor functions. Their search is based on Luria's proposal for neuropsychological diagnosis. Example: "when I lift my finger, you lift your wrist; when I lift my wrist, you lift

your finger; when I knock on the table once, you knock twice, when you knock twice, I knock once" (Marino & Julián, 2010; Tirapu-Ustárrozet al., 2005).

Wisconsin Card Sorting Test (WCST). This test was created in 1948, and reviewed afterwards. Its goal is to evaluate abstract reasoning and coping strategies (Huber, 1992; Trentini, Argimon, Oliveira, & Werlang, 2010). This test used a modified, shorter version as a tool for evaluating executive functions. We used this version because the application is briefer, since it contains 48 cards (Nelson, 1976).

Trail Making Test (TMT). This is a widely used neuropsychological assessment instrument. It evaluates the ability to engage in the task, mental flexibility, working memory, motor dexterity, and visual tracking. It is composed by two parts: part A, with 25 circles containing numbers; and part B, with numbers and letters which must be connected following a sequence. Results are based on the time spent to resolve each part (Lezak, 1995, 2005; Strauss et al., 2006).

Rey Complex Figures. This instrument can be used to evaluate planning skills, providing a systematic analysis of the participant's answers. The quality of the fragmented copy suggests difficulty in planning. The assessment considers the way the patient starts copying, the time spent to complete the task, and the answer's organization (Lezak, 2005).

Procedures

Initial contact with third age groups and retirement groups was carried out in order to explain the study and invite them to participate. We also used the snowball methodology (Biernacki & Waldorf, 1981) and ads in two community newspapers to find patients. When they made contact, the application of the instruments and the sessions of Cognitive Training (CT) were scheduled. The elderly were directed to groups of 10 people and, in a specific one, were trained (Experimental Group [EG]). The Control Group (CG) did not receive any training; they only participated in the pre-test and, after 60 days, in the post-test. The participants received feedback from the study after it was over. Two application protocols were developed, Protocol A and Protocol B, whereas the order of the instruments was inverted to control the fatigue of the participants. Research data collection occurred from April to September 2013. The study was conducted at the researcher's office, in four phases:

Phase 1

First contact with the patients, explaining the study and signing the Free and Clarified Consent. The interviews were done and then the instruments were applied in the following order: MMSE, GDS-30, BAI, and WHOQOL-OLD. After that, the elderly were included or excluded according to the inclusion/exclusion criteria. Each participant took nearly one hour to conclude this phase.

Phase 2

All the elderly, from the EG and the CG, submitted to the application of the instruments to evaluate executive functions, in the following order: Digit Span (DDO and DIO); Vocabulary (V); Block Design (BD); Coding (Cd); Symbol Search (SS); Letter-Number Sequencing (LNS); Rey Complex Figures (RCF); Sternberg Paradigm; Verbal Fluency (animal category); F-A-S; Rey Auditory-Verbal Learning Test (RAVLT); Stroop Test – Colors and Words; Go-No-Go Tasks; Wisconsin Card Sorting Test (WCST). This phase took the participants nearly one hour and thirty minutes for completion.

Phase 3

The elderly from the Experimental Group (EG) participated in training sessions. There were eight intervention sessions, based on Irigaray et al. (2012), regarding the EF, Yassuda, Batistoni, Fortes, and Neri (2006), and Irigaray, Schneider e Gomes (2011). The present study placed more emphasis on the EF and quality of life, which were the main subjects of this research. The eight sessions were split into four sessions of EF training – which involved attention, working memory, planning, and decision making, and the last four sessions focused on memory training. Trained psychologists and psychology students administered the sessions. The sessions were done once a week, lasting 90 minutes each. Both the assessment and the training phases required a protocol. The CG did not receive any training.

Phase 4

The EG performed the post-test nearly one week after the last training session. The CG performed the post-test 60 days after the pre-test. The same instruments used in the pre-test were used in the post-test.

Eight-session Cognitive Training program for executive functions and memory (Irigaray et al., 2011; Yassuda et al., 2006).

Table 2.
Content of the Cognitive Training Sessions

Sessions and Functions	Strategies for the Training of Executive Functions
Executive Functions 1st Session:	Presentation of the research. Lecture and opportunity to discuss: executive function (planning and organization). Exercise: answer ten questions that demand solutions for everyday problems. Group debate about the exercise. Exercise: Each participant will look at a model and identify, by corresponding numbers, the part that completes the model, among five alternatives. Participants will try completing ten models. Group debate about the exercise. Homework: participants will receive five illustrated cards which, when organized correctly, tell a story. The figures must be organized to create a story with logic. The story must be written and presented on the next session.
Executive Functions 2nd Session:	Homework: participants will receive ten incomplete figures. They will name the part that is missing in each figure. Brief review of the last class. Lecture and opportunity to discuss: executive functions and aging. Exercise: participants answer ten questions that show their understanding of social rules and concepts. Group debate about the exercise. Exercise: Reading and discussing a short text. Homework presentation and discussion.
Executive Functions 3rd Session:	Homework: answer ten questions about the meaning of popular sayings. For example, what does this saying mean: "Water dripping day by day wears the hardest rock away". Brief review of the last class. Lecture and opportunity to discuss: executive functions (mental flexibility) Exercise: Each participant will receive a different set of five illustrated cards that, when organized correctly, tell a story. The figures must be organized to create a story with logic. The participants must write and present the story to the group. Exercise: Participants receive puzzle parts that, when organized correctly, form a picture of common objects. They must assemble and create a story for each of them. Group debate about the exercise. Homework presentation and discussion.
Executive Functions 4th Session:	Homework: participants will receive a story book. They must read and summarize the story. What was the main subject of the story? Brief review of the last class. Lecture opportunity to discuss: executive functions (inhibition of improper actions and irrelevant sensory information). Exercise: Group reading and discussing a brief text. Homework presentation and discussion. Review of the cognitive training.
Memory 5th Session:	Homework: read pages 17 to 31 of the book *DeuBranco* (Alvarez, 2007) and answer in a separate sheet: List different types of memory. Can you give any examples? What are the memory phases? Lecture and opportunity to discuss: the stages of memorization (attention, recording e recollection). Attention exercise: participants individually observe a picture for 3 minutes. Next, they form pairs and tell each other everything they saw in the picture, which they cannot see anymore. Lecture and opportunity to discuss: the sub-systems of memory (immediate memory, working memory, long-term memory). Working memory exercise: choose three words in alphabetical order without writing them down. Target task: explaining the benefits of highlighting to memorize texts, and a text memorization exercise for which participants were encouraged to use highlighters
Memory 6th Session:	Homework: read pages 33 to 39 and 51 to 61 of the book *Deu Branco* (Alvarez, 2007) and answer in a separate sheet: What are the main alterations that happen in memory as we age? Give examples of things you can do to improve your memory. Brief review of the last class. Lecture and opportunity to discuss: aspects of memory that are altered and aspects that are not altered by aging. Attention exercise: sequences of knocks on the table are turned into digits. For example: *** * ** becomes 3, 1, 2. Working memory exercise: participants observe fragments of words on the board (ta, cof, fee, ble) and mentally form words without using the same fragment twice (table, coffee) and without writing them down. Target task: explaining the benefits of organization on memory; explaining how to organize a shopping list in categories (offering an example); memorization exercise: making a list using categories.

(Cont. Table 2)

Sessions and Functions	Strategies for the Training of Executive Functions
Memory 7th Session:	Homework: read pages 63 to 74 of the book *Deu Branco* (Alvarez, 2007) and answer in a separate sheet: What internal strategies can you use to memorize the way to your new doctor? To record personal information about a new friend? To remember the name of a restaurant? Brief review of the last class. Lecture and opportunity to discuss: presentation of external mnemonic techniques (calendars, lists, alarms, environmental changes) and ways to use them efficiently. Divided attention exercise: participants observe a pattern drawn on the board containing several squares, circles, triangles, and hearts; while they repeat a syllabic sequence aloud (pa-pa-ra-pa-pa), they must count how many figures of each type are on the board. Working memory exercise: participants mentally solve simple mathematical problems presented on the board (8 x 2, 3 x 4, 7 x 5) and then add the partial results. Target task: explaining the benefits of highlighting to memorize texts, and a text memorization exercise, in which participants were encouraged to use highlighters.
Memory 8th Session:	Homework: read pages 74 to 84 of the book *Deu Branco* (Alvarez, 2007) and answer in a separate sheet: What is the distributed practice technique for? What can we do to remember information that is *on the tip of the tongue*? Brief review of the last class. Lecture and opportunity to discuss: presentation of internal mnemonic techniques (verbal associations, mental images, stories) and ways to use them efficiently. Attention exercise: phonological domain. A participant says a word (affectionate) and the next one must say a word that begins with the last syllable of this word (telephone). Working memory exercise: put words (for example, adult, baby, adolescent) in the correct time sequence (baby, adolescent, adult). Target task: explaining the benefits of organization on memory; explaining how to organize a shopping list into categories (offering an example); memorization exercise: making a list using categories. (Irigarayet al., 2012; Yassudaet al., 2006). Adapted.

The 58 elderly participated in the pre-test using Protocol A; 37 responded Protocol B. Three elderly quit the survey due to health problems during the pre-tests. This was the Experimental Group (EG). 47 elderly participated in the Control Group (CG) pre-test, whereas 24 responded Protocol A, and 23 responded Protocol B.

During the second phase – training–, 95 elderly started the participation of eight training sessions to train executive functions. However, 24 elderly, for various reasons (travel, diseases, etc.) did not begin the training, thus,71 participants remained; nine elderly participated in only one session; three attended two sessions; two participated in four sessions; two participated until the fifth session, two attended six sessions; one until the seventh session. Only 52 elderly completed the eight training sessions. Still during the second phase, the elderly who did not receive any training (CG) answered, after eight weeks, the same instruments used in the pre-test with 47 elderly (CG). However, only 38 elderly (CG) attended the post-testing session. Hence, 7 participants from the CG gave up and did not participate in the post-test. Only 52 elderly from the EG were supposed to participate in the post-test, but only 45 finally did. Thus, the final sample of this study was 45 elderly in the EG and 38 in the CG (the flowchart is attached).

Data analysis

Quantitative variables were described using average and standard deviation, or median and inter quartile range. Categorical variables were described using absolute and relative frequencies. The Student test was applied to compare the groups' averages. The Mann-Whitney test was used in asymmetry cases. Pearson's chi-square test or Fisher's exact test were used to compare proportions. The Student-*t* test was used for intragroup comparisons of paired samples (symmetric distribution), and the Wilcoxon test for asymmetric distributions. A two-way ANOVA was used to compare the parameter variations between the moments according to each group. The level of significance used was 5% ($p \leq 0.05$), and the analyses were done by using the SPSS, version 21.0.

Ethical aspects

This study was approved by the Scientific Committee of the Psychology Faculty and by the Ethics Committee

of PUCRS (CAAE nº 12324413.4.0000.5336). The ethical procedures were adequate and the Free and Clarified Consent Term was used. Thus, the elderly who agreed to participate knew the survey and signed the term.

RESULTS

The results will be presented descriptively and on tables for better understanding of the research. Regarding the number of patients in the first phase of the survey, 145 elderly participated in the pre-test; however, only 57.25% (n = 62), of the elderly participated in all the phases, that is, 83 people. 62 elderly did not participate in the study – thus, 42.76% of those who participated in the pre-test. The 83 elderly who participated in all the phases of the survey were divided into two groups: 45 people enrolled in the Experimental Group (EG), and 38 enrolled in the Control Group (CG). The difference in the number of participants between each group is not considered enough to hinder the results of the statistical analyses.

Regarding gender, the sample was composed of 16 males (19.45%) and 67 females (80.55%). Both male and female participants were divided into the EG and the CG. The CG was composed of 38 elderly, eight male (21.1%) and 30 female (78.9%), aged from 60 to 83 years old (M= 68.3%; SD 6.3). The EG was composed of 45 elderly, eight male (17.8%) and 37 female (82.2%), aged from 60 to 80 years old (M= 69.2%; SD 6.1). Statistical analyses did not show any significant differences between the ages and sexes of the participants; therefore, the groups were similar.

Table 3 displays the sociodemographic characteristics of the sample. There was no significant difference between the CG and the EG regarding age, and the sample was considered homogeneous (EG: 69.2, SD: 6.1; and CG: 68.3, SD: 6.3; $P = 0.500$). Participants who are aged under 80 years old are considered young elderly people according to Monteiro (2006) and Camarano (2004), who mention that it is common to divide this stage of development in young elderly people, from 60 to 79 years old, and older elderly people, aged over 80 years old.

Regarding the marital status, most participants were married (EG: M = 62.2; CG: M = 50), and the groups were considered homogeneous as well. Most participants had an incomplete higher education (EG: M= 12.6, SD 5.0; CG: M= 12.1, SD 5.0), thus presenting high levels of education, which differs from other studies (Yassuda et al., 2006; Irigaray et al., 2012; Lima-Silva et al., 2012; Brum et al., 2009), and is similar to a study by Nouchi, Taki, Takeuchi, Hashizume and Akitsuki (2012).

Table 3.
Characteristics of the sample

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	***P* value**
Age (years)	69.2 ± 6.1	68.3 ± 6.3	0.500
Gender			0.922
Male	8 (17.8)	8 (21.1)	
Female	37 (82.2)	30 (78.9)	
Marital status			0.390
Married	28 (62.2)	19 (50.0)	
Single	1 (2.2)	4 (10.5)	
Widowed	9 (20.0)	8 (21.1)	
Separated/Divorced	7 (15.6)	7 (18.4)	
Education	12.6 ± 5.0	12.1 ± 5.0	0.621
Lives			0.434
Alone	13 (28.9)	15 (39.5)	
With someone	32 (71.1)	23 (60.5)	
Working			1.000
Yes	3 (6.7)	3 (7.9)	
No	42 (93.3)	35 (92.1)	
Monthly income			0.098
Up to 2 m.w.	4 (8.9)	10 (26.3)	
From 2 to 4 m.w.	14 (31.1)	11 (28.9)	
≥ 5 m.w.	27 (60.0)	17 (44.7)	
Socioeconomic class			0.527
A	9 (20.9)	6 (15.8)	
B	21 (48.8)	16 (42.1)	
C/D	13 (30.2)	16 (42.1)	

(Cont. Table 3)

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	***P* value**
Do you have/Have you ever had any major diseases or health problems?			0.048
Yes	32 (71.1)	18 (47.4)	
No	13 (28.9)	20 (52.6)	
Have you ever had any mental disease?			1.000
Yes	9 (20.0)	7 (18.4)	
No	36 (80.0)	31 (81.6)	
Have you ever participated in psychological or psychiatric treatments?			0.054
No	22 (48.9)	27 (71.1)	
Yes, but not anymore.	11 (24.4)	8 (21.1)	
Yes, and I still do.	12 (26.7)	3 (7.9)	
Smoking			0.418
Yes	14 (31.1)	16 (42.1)	
No	31 (68.9)	22 (57.9)	
Do you drink alcohol?			0.575
Yes	24 (53.3)	17 (44.7)	
No	21 (46.7)	21 (55.3)	
Physical activities			0.033
Never	8 (18.6)	11 (28.9)	
Eventually	4 (9.3)	10 (26.3)	
Regularly	31 (72.1)	17 (44.7)	
Leisure activities			
Watching TV	39 (86.7)	36 (94.7)	0.279
Reading	34 (75.6)	33 (86.8)	0.308
Traveling	31 (68.9)	21 (55.3)	0.293
Walking	30 (66.7)	24 (63.2)	0.918
Using the computer	29 (64.4)	21 (55.3)	0.531
Music	28 (62.2)	22 (57.9)	0.860
Going to the beach	28 (62.2)	23 (60.5)	1.000
Crossword puzzles	24 (53.3)	24 (63.2)	0.497
Parties	20 (44.4)	16 (42.1)	1.000
Movies	19 (42.2)	22 (57.9)	0.229
Going to the mountains	17 (37.8)	13 (34.2)	0.914
Crafts	14 (31.1)	12 (31.6)	1.000
Church activities	13 (28.9)	8 (21.1)	0.572

Note: * described by average ± SD, mean (percentage 25-75) or n (%)

An important finding is the significant difference between groups regarding health problems ($P = 0.048$) and physical activities ($P = 0.033$). The elderly in the Experimental Group were more prone to present diseases, but also practiced more physical activities than the Control Group.

Comparison between groups showed a significant difference in the number of errors of the Sternberg Paradigm instrument ($P = 0.008$), WCST completed categories ($P = 0.039$), and Symbol Search (weighted points) ($P = 0.039$), which can be seen on Table 4. The CG reduced the number of errors in the Paradigm significantly more than EG, and increased the weighted score in Symbol Search significantly more as well. This last result may be explained by the initial difference between groups ($P = 0.049$). However, the EG increased the number of completed categories in the WCST in comparison with the CG. The EG also presented higher scores in the total number of words in the F-A-S test after the intervention ($P = 0.005$).

Intragroup comparisons showed that the EG improved significantly after the intervention in the following instruments: GDS ($P = .046$), RAVLT ($P < 0.001$), Rey Complex Figures – Memory ($P = 0.001$), Digit Span DO ($P = 0.046$), and Digit Span – weighted score ($P = 0.002$). The CG improved significantly on the following instruments: BAI ($P = 0.008$), Rey Complex Figure – Memory ($P = 0.022$), Sternberg Paradigm ($P = 0.008$), and Symbol Search – weighted score ($P < 0.001$).

The Stroop Test was used to assess the inhibition and interference control and automatisms, in the Victoria version (Strauss et al., 2006). The elderly did not present many errors, which showed a good quality of work. The EG did not present errors at Stroop I, Stroop II, and Stroop III; the CG presented only one error, at Stroop III.

Table 4.
Evaluation of the clinical profile and estimated intelligence ability (estimated cognitive status)

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	P value
MMSE			
Pre	27.6 ± 2.2	27.9 ± 2.0	0.552
Post	28.0 ± 1.5	28.0 ± 1.5	1.000
Delta (Δ)	0.4 ± 2.5	0.1 ± 2.0	0.582
P (intragroup)	0.338	0.812	
GDS			
Pre	5 (4 to 7)	6 (4 to 7)	0.452
Post	4 (3 to 6)	5 (3 to 6)	0.321
Delta (Δ)	-1 (-2 to 0.5)**	0 (-1 to 1)	0.390
P (intragroup)	**0.046**	0.129	
BAI			
Pre	8 (4 to 15)	7.5 (3 to 13)	0.507
Post	7 (4 to 14)	4 (2 to 13)	0.066
Delta (Δ)	-1 (-4,5 to 3.5)	-2 (-5 to 0)**	0.225
P (intragroup)			
Block Design Raw Score			
Pre	24.8 ± 8.58	26.0 ± 10.7	0.594
Post	24.5 ± 9.20	27.8 ± 10.4	0.129
Delta (Δ)	-0.36 ± 9.55	1.82 ± 6.96	0.248
P (intragroup)	0.804	0.116	
Vocabulary Raw Score WAIS-III			
Pre	31.4 ± 9.65	35.9 ± 9.8	**0.040**
Post	34.9 ± 10.6	38.0 ± 9.0	0.165
Delta (Δ)	3.49 ± 7.42*	2.08 ± 7.19	0.384
P (intragroup)	**0.003**	0.083	
Clock Drawing Test (CDT)			
Pre	4.18 ± 1.11	4.37 ± 0.94	0.417
Post	4.49 ± 0.87	4.32 ± 1.12	0.430
Delta (Δ)	0.30 ± 1.32	-0.05 ± 0.77	0.143
P (intragroup)	0.146	0.676	

Note: * Described by average ± SD or mean (percentage 25-75); ** significant difference in pre- and post-intervention evaluations according to paired Student-*t* test or Wilcoxon test ($p<0.05$).

Table 5.
Attention and Processing Speed Assessment, pre and post-intervention, separated by group.

Variables*	Experimental Group (n=45)	Control Group (n=38)	P value
Attention and Processing Speed			
Digit Span Raw Score (DO+IO) WAIS-III	Value	Value	
Pre	13.5 ± 4,2	13.9 ± 4.9	0.721
Post	14.3 ± 4,1	14.3 ± 4.4	0.982
Delta (Δ)	0.80 ± 3.07	0.42 ± 4.78	0.664
P (intragroup)	0.088	0.590	
TMT – Part A – Time			
Pre	59 (51 to 79)	56 (48 to 75)	0.586
Post	62 (49 to 88)	58 (49 to 76)	0.448
Delta (Δ)	2 (-9.8 to 17.5)	-2 (-13.3 to 6.0)	0.177
P (intragroup)	0.357	0.243	
TMT – Part B – Time			
Pre	141 (107 to 241)	153 (119 to 223)	0.512
Post	129 (102 to 211)	152 (110 to 227)	0.357
Delta (Δ)	-9 (-53 to 34)	2.5 (-36.3 to 37.3)	0.624
P (intragroup)	0.655	0.994	
Coding Raw Score WAIS-III			
Pre	45.2 ± 13.9	44.5 ± 14.5	0.696

(Cont. Table 5)

Variables*	Experimental Group (n=45)	Control Group (n=38)	P value
Post	45.3 ± 15.3	45.7 ± 16.6	0.913
Delta (Δ)	0.13 ± 10.1	1.22 ± 1.3	0.632
P (intragroup)	0.930	0.477	
Symbol Search Raw Score			
Pre	21.5 ± 7.64	18.2 ± 6.66	**0.041**
Post	22.2 ± 9.26	21.7 ± 6.80	0.766
Delta (Δ)	0.67 ± 8.68	3.42 ± 4.89*	0.086
P (intragroup)	0.609	**<0.001**	

Note: * Described by average ± SD or mean (percentage 25-75); ** significant difference in pre- and post-intervention evaluations according to paired student t test or Wilcoxon test (P <0.05).

Table 6.
Evaluation of Executive Processes, pre- and post-intervention, according to group.

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	***P value***
Working Memory/Phonological loop			
Digit Span Raw Score (DO+IO) WAIS-III			
Pre	13.5 ± 4.2	13.9 ± 4.9	0.721
Post	14.3 ± 4.1	14.3 ± 4.4	0.982
Delta (Δ)	0.80 ± 3.07	0.42 ± 4.78	0.664
P (intragroup)	0.088	0.0590	
Digit Span IO WAIS-III			
Pre	5.38 ± 2.21	5.34 ± 2.37	0.944
Post	5.56 ± 2.55	5.47 ± 2.04	0.874
Delta (Δ)	0.18 ± 2.04	0.13 ± 2.40	0.925
P (intragroup)	0.561	0.737	
RAVLT A1			
Pre	5.09 ± 1.52	4.79 ± 1.29	0.342
Post	6.44± 1.93	5.47± 1.81	**0.022**
Delta (Δ)	1.36± 2.08	0.68 ± 1.76	0.120
P (intra grupo)	<0.001	0.022	
RAVLT A2			
Pre	7.13 ± 2.20	6.47± 2.15	0.173
Pos	8.71± 2.90	7.45 ± 2.23	**0.031**
Delta (Δ)	1.58± 2.46	0.97 ± 2.59	0.281
P (intragroup)	**<0.001**	0.026	
RAVLT A3			
Pre	8.49 ± 2.74	8.08 ± 2.74	0.499
Post	9.78 ± 2.96	8.66 ± 2.52	0.070
Delta (Δ)	1.29 ± 2.28	0.58 ± 2.55	0.185
P (intragroup)	**<0.001**	0.171	
RAVLT A4			
Pre	9.40 ± 2.86	9.05 ± 2.72	0.575
Post	10.3 ± 3.28	9.61 ± 2.59	0.302
Delta (Δ)	0.89 ± 2.99	0.55 ± 2.69	0.594
P (intragroup)	0.052	0.213	
RAVLT A5			
Pre	9.93 ± 2.91	10.1 ± 2.66	0.749
Post	10.7 ± 3.38	10.1 ± 2.75	0.359
Delta (Δ)	0.78 ± 2.56	0.00 ± 2.74	0.158
P (intragroup)	**0.047**	0.906	
RAVLT Complete (A1 to A5)			
Pre	39.3 ± 11.1	38.6 ± 9.5	0.734
Post	45.9 ± 13.0	41.2 ± 10.4	0.075
Delta (Δ)	6.6 ± 10.0**	2.7 ± 9.0	0.065
P (intragroup)	**<0.001**	0.078	
RAVLT B1			
Pre	4.91 ± 1.95	4.53 ± 1.80	0.356
Post	5.31 ± 2.05	4.45 ± 1.78	**0.046**
Delta (Δ)	0.40 ± 1.91	0.08 ± 2.21	0.293
P (intragroup)	0.167	0.827	

(Cont. Table 6)

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	***P value***
RAVLT A6			
Pre	7.96 ± 3.05	7.89 ± 3.17	0.929
Post	9.73 ± 3.66	8.13 ± 3.19	**0.038**
Delta (Δ)	1.78 ± 3.13**	0.24 ± 2.73	0.020
P (intragroup)	**<0.001**	0.595	
RAVLT A7			
Pre	7.89 ± 3.25	7.61 ± 3.91	0.723
Post	9.44 ± 3.94	8.18 ± 3.92	0.150
Delta (Δ)	1.43 ± 3.16**	0.58 ± 3.41	0.244
P (intragroup)	**0.004**	0.303	
RAVLT Recognition			
Pre	13.0 ± 2.66	12.8 ± 1.87	0.690
Post	12.5 ± 3.36	12.9 ± 1.87	0.564
Delta (Δ)	-0.43 ± 3.98	0.08 ± 2.17	0.493
P (intragroup)	0.513	0.821	
Codification/maintenance			
Sternberg Paradigm Omissions			
Pre	2 (0 to 3.5)	2 (1 to 5)	0.231
Post	2 (0 to 5)	3 (1 to 4)	0.250
Delta (Δ)	0 (-2 to 3)	0.5 (-2 to 2)	0.741
P (intragroup)	0.588	0.912	
Sternberg Paradigm Errors			
Pre	2 (0 to 4)	3 (1 to 5)	0.297
Post	2 (0.5 to 4)	1 (0 to 3)	0.090
Delta (Δ)	0 (-1 to 1)	-2 (-2 to 0.3)**	0.008
P (intragroup)	0.598	**0.008**	
Maintenance/manipulation			
LNS Raw Score WAIS-III			
Pre	7.91 ± 2.85	8.58 ± 2.92	0.296
Post	8.02 ± 3.41	7.89 ± 2.62	0.851
Delta (Δ)	0.11 ± 3.61	-0.53 ± 2.98	0.279
P (intragroup)	0.837	0.158	
Semantic/Phonological Access – Verbal fluency			
Total number of words – F-A-S Test			
Pre	37.6 ± 11.2	33.8 ± 10.3	0.122
Post	40.2 ± 11.9	33.4 ± 8.6	**0.005**
Delta (Δ)	2.60 ± 9.62	-0.45 ± 5.94	0.094
P (intragroup)	0.077	0.645	
Total number of Animals			
Pre	15.7 ± 3.6	15.2 ± 4.3	0.568
Post	16.6 ± 4.6	15.2 ± 4.0	0.134
Delta (Δ)	0.91 ± 3.67	0.00 ± 4.51	0.317
P (intragroup)	0.107	1.000	
Inhibition – Control of Interference and Automatism			
STROOP I Rectangles–Time			
Pre	29.1 ± 16.4	26.4 ± 9.9	0.380
Post	24.2 ± 7.8	23.6 ± 8.3	0.716
Delta (Δ)	-4.89 ± 16.6	-2.84 ± 11.0	0.518
P (intragroup)	0.055	0.119	
STROOP II Words–Time			
Pre	29.3 ± 11.9	28.8 ± 7.4	0.843
Post	27.2 ± 10.8	27.8 ± 11.1	0.785
Delta (Δ)	-2.11 ± 9.36	-1.03 ± 11.3	0.633
P (intragroup)	0.115	0.245	
STROOP III Ignoring Word–Time			
Pre	44.2 ± 23.0	43.6 ± 16.5	0.898
Post	42.2 ± 16.7	42.0 ± 12.7	0.934
Delta (Δ)	-1.93 ± 13.8	-1.63 ± 13.4	0.920
P (intragroup)	0.354	0.459	
Go/No-Go–Errors			
Pre	1 (0 to 3)	1 (0 to 2)	0.664
Post	1 (0 to 2)	1 (0 to 2)	0.538
Delta (Δ)	0 (-2 to 0.8)	-0.5 (-2 to 1)	0.648
P (intragroup)	0.118	0.331	

(Cont. Table 6)

Variables*	Experimental Group (*n*=45)	Control Group (*n*=38)	***P value***
Go/No-Go–Omissions			
Pre	0 (0 to 0)	0 (0 to 1)	0.130
Post	0 (0 to 0)	0 (0 to 0)	0.797
Delta (Δ)	0 (0 to 0)	0 (-1 to 0)	0.440
P (intragroup)	0.296	0.752	
Cognitive flexibility – Alternation of cognitive sets			
WCST – Completed categories			
Pre	5.02 ± 1.36	5.26 ± 1.20	0.398
Post	5.56 ± 0.87	5.00 ± 1.54	0.053
Delta (Δ)	0.53 ± 1.27**	-0.26 ± 2.01	**0.039**
P (intragroup)	**0.007**	0.425	
WCST – Perseverative errors			
Pre	3 (0.5 to 7)	5.5 (1 to 13)	0.056
Post	3 (0 to 6.5)	2.5 (0 to 8)	0.907
Delta (Δ)	0 (-4 to 3.5)	-1 (-11.3 to 6)	0.415
P (intragroup)	0.466	0.123	
WCST–Total of errors			
Pre	7 (0.5 to 17)	10.5 (4.8 to 15.3)	0.261
Post	7 (1 to 11.5)	6.5 (1 to 12.5)	0.872
Delta (Δ)	-2 (-7.5 to 6)	-3 (-11 to 5.3)	0.787
P (intragroup)	0.343	0.233	
WCST – Non-perseverative errors			
Pre	0 (0 to 0.5)	0 (0 to 0)	0.321
Post	0 (0 to 1)	0 (0 to 0)	0.030
Delta (Δ)	0 (0 to 1)	0 (0 to 0)	0.197
P (intragroup)	0.234	1.000	
WCST – Administered trials			
Pre	42.0 ± 6.7	43.1 ± 4.7	0.354
Post	42.3 ± 6.0	39.2 ± 9.8	0.079
Delta (Δ)	0.33 ± 9.05	-3.97 ± 11.3**	0.058
P (intragroup)	0.806	**0.037**	
Planning			
REY – Copy test			
Pre	31.0 ± 4.7	30.8 ± 5.6	0.804
Post	31.6 ± 5.5	31.1 ± 6.1	0.686
Delta (Δ)	0.6 ± 6.2	0.3 ± 5.5	0.856
P (intragroup)	0.166	0.296	
REY–Memory			
Pre	13.2 ± 6.3	12.7 ± 6.6	0.721
Post	15.5 ± 7.2	14.0 ± 7.4	0.364
Delta (Δ)	2.3 ± 4.4**	1.4 ± 3.5**	0.279
P (intragroup)	0.001	0.022	

Note: * Described by average ± SD or mean (percentage 25-75); ** significant difference in pre- and post-intervention evaluations according to paired student-*t* test or Wilcoxon test (P < 0.05).

DISCUSSION

One of the main objectives in the field of cognitive training for the elderly is to improve EF and processing speed. In this context, the results presented here show the effect of executive training in improving the EF, which include processing speed. Both EF and processing speed decline with age (Salthouse, 1996). Daily activities are strongly related to these functions (Vaughan & Giovanello, 2010).

Most participants were married. Furthermore, most of them presented incomplete higher education, therefore, there was a high level of education when compared to other studies (Yassuda, Batistoni, Fortes, & Neri, 2006; Irigaray, Schneider & Gomes, 2012); Lima-Silva et al., 2012; Brum, Forlenza, & Yassuda, 2009), although it was similar to a study by Nouchi, Taki, Takeuchi, Hashizume e Akitsuki (2012).

When comparing the groups, there were significant differences related to variation in the number of errors at the following instruments: Sternberg Paradigm, WCST Completed Categories, and Symbol Search. Intragroup comparisons showed that the EG improved significantly after the intervention as shown by the scores of GDS, RAVLT, Rey Complex Figures–Memory, Digit Span–DO, Digit Span – Total, and Vocabulary., The improvement in the CG was significant at the following tests: BAI, Rey

Complex Figures – Memory, number of errors in the Sternberg Paradigm, and Symbol Search. These results suggest there is a possibility that the elderly can improve EF and processing speed through the training of executive functions with tasks that stimulate this function.

Thus, it was concluded that cognitive training improved the following executive function components:

Estimated Cognitive Ability

A significant improvement in the Vocabulary of both groups was found, which refers to the ability to learn and acquire new verbal information.

Attention and Processing Speed

There was improvement in the ability to process information automatically, without conscious thinking.

Working Memory (updating), Phonological loop, Codification/maintenance, Semantical/Phonological Access, Verbal Fluency

There was significant difference in the following instruments: RAVLT, LNS, F-A-S, Ray Complex Figures–Memory, and the Sternberg Paradigm.

Cognitive Flexibility and Alternation of Cognitive sets

There was a significant difference in the number of completed categories of WCST.

Planning and Problem Solving

Significant differences in the Rey Complex Figures test were found. However, the results need be replicated in larger samples. The long-term effects and the relevance to daily functioning remain unclear. We also suggest the effects be verified through a longitudinal study, since it was not observed if the improvements linger if the elderly do not continue the cognitive training.

The EF training program for the elderly also improved the survey participants' cognitive ability and quality of life. This may postpone degenerative conditions associated with aging, if the training continues. The implementation of executive function training programs for the elderly is very important to maintain their cognitive abilities and prevent cognitive deterioration, resulting in a better quality of life.

One limitation of this study was the low number of participants in the sample, which indicates that the results from data analyses are actually a trend. If there had been more participants, the differences found might have been greater. Hence, a bigger sample may engender more reliable results and show more differences.

The survey's small sample was composed of community elderly, all selected by convenience and cognitively preserved. Hence, the results presented here cannot be generalized, and they do not contemplate elderly people with mild cognitive impairment or dementia, other age groups, and inpatients.

Thus, it is important to reinforce the need for prospective studies to determine whether the conclusions of the present study are applicable to other clinical populations, and whether changes in the executive functions, especially in cognitive processes, are connected to changes in the elderly quality of life. Researchers must consider the assessment of these cognitive processes and how patients perceive their health status, which is regarded as the quality of life related to executive processes.

The challenges of working with the elderly should be highlighted. They usually have many doctor appointments, are more vulnerable to diseases during winter, have more difficulties with public transportation, among other things. These limitations induced many elderly to quit the training sessions. If these variables had not been present, it might have been a more comprehensive sample and, consequently, more reliable results.

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