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Comparison of Two Cognitive Training Programs With Effects on Functional Activities and Quality of Life

Magdaléna Hagovská, PhD; Oliver Dzvoník, CSc; and Zuzana Olekszyová, MD

ABSTRACT

The aim of the current study was to compare the effectiveness of two types of cognitive training in 60 older adults with mild cognitive impairment by assessing the impact on functional activities, quality of life (QOL), and various cognitive functions. The primary outcomes were functional activity level and QOL. The secondary outcome was cognitive examination. Group assignment was random. Group A (n = 30) underwent CogniPlus, a computer-based, cognitive training. Group B (n = 30) underwent classical group-based cognitive training. Both programs comprised two 30-minute sessions per week for 10 weeks. After training, group A had better QOL ($p < 0.001$, effect size [ES] = 0.69) and better attention (increased load score, $p < 0.05$, ES = –0.23; errors, $p < 0.001$, ES = –0.47); however, there were no group differences in functional activity level. Group A demonstrated larger improvements in QOL and attention than group B (i.e., classical cognitive training), but the transfer to functional activities was the same between groups.

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Mild cognitive impairment (MCI) describes a mild decline in one or more cognitive domains and is often associated with age. Cognition is considered to be worse than expected for age; however, basic activities of daily living (ADLs) remain unaffected (Albert et al., 2011). Prevalence estimates of MCI range from 16% to 20% for the majority of reviewed studies (Roberts & Knopman, 2013).

Individuals with MCI often have difficulty remembering new information and maintaining their attention, or they may take longer than their healthy counterparts to perform more cognitively demanding, goal-directed activities, such as calculations, operating a mobile phone, buying a train ticket, or completing documents (Aretouli & Brandt, 2010). In 2011, the United Kingdom's National Institute for Health and Clinical Excellence (NICE; NICE & Social Care Institute for Excellence [SCIE], 2011) recommended the use of various types of cognitive training to stimulate cognition in older adults with MCI.

In recent years, there has been growing interest in cognitive training for older adults, resulting in an in-

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crease in knowledge about the efficacy of the various forms of cognitive training, cognitive stimulation, and cognitive rehabilitation (Kueider, Parisi, Gross, & Rebok, 2012). These programs are intended to improve cognition as well as everyday functioning and quality of life (QOL). Studies of cognitive training programs suggest that although performance on the trained tasks improves, there is minimal transfer of gains to functional activities in older adults (Bheher, 2015). A meta-analysis concluded that individuals who underwent MCI cognitive training interventions had moderate improvements in functional abilities and small improvements in QOL and ADLs (Li et al., 2011).

Cognitive video games may also increase older adults' ability to learn new tasks and adapt to new situations; however, there is no clear evidence that such improvements are reflected in improvements in ADLs and QOL (Bahar-Fuchs, Clare, & Woods, 2013). A study by Vidovich et al. (2015) found that a group-based program of cognitive activity produced minimal improvements in attention and QOL. Thus, there is an urgent need to establish whether the various novel cognitive training programs and dual-task exercises designed for older adults with MCI are effective not only in improving cognitive functioning, but also the ability to perform functional activities and QOL (Vidovich et al., 2015).

The current study investigated the effectiveness of two types of cognitive training. The CogniPlus is a computer-based individual training program that is based on up-to-date, scientific knowledge about cognitive functions and the ways in which they can be trained (Schuhfried GmbH, 2014). Standard group-based cognitive training interventions are delivered in group contexts and their objective is to improve, maintain, or restore mental functions through repeated and structured practice of tasks (Walsh, 2005). The main differences between these two types of training are that CogniPlus is a computer-based program. The program also allows physical exercises to be combined with cognitive exercises and this dual-task condition places a heavier demand on attention. The classical group-based cognitive program offers more opportunities for interaction, is delivered in a more playful style, and demands less attention. Despite these differences, both programs were designed to produce improvements in cognitive functioning that would transfer to functional activities.

The purpose of the current study was to compare two types of cognitive training programs—the CogniPlus (i.e., a computer-based, individual program) and a classical, group-based program—in older adults with MCI to determine which produced the best transfer of gains to functional activities and QOL and the biggest improvements in cognitive functions.

METHOD

The sample comprised individuals with confirmed MCI (based on standard clinical examinations administered by a neurologist, psychiatrist, and clinical psychologist) as defined by Albert's criteria (Albert et al., 2011). The study was performed in outpatient psychiatric clinics to which older patients from all over eastern Slovakia are referred for diagnosis and treatment.

Between June 2013 and March 2014, of 160 patients with a diagnosis of MCI in the outpatient psychiatric clinics' database, 80 were randomly selected by means of a computer program (allocation ratio 1:1) and received a telephone invitation to participate in the study.

Inclusion criteria were reaffirmation of MCI diagnosis by a neurologist, psychiatrist, and psychologist using standard clinical examination and a neuropsychological testing battery, and age >65 years. The neuropsychological test battery from the Psychiatric Center of Prague (Preiss et al., 2012) was used. Neuropsychological assessment was performed to assess working memory, attention, executive functions, verbal fluency, depression, and intelligence. The tests were administered by a clinical psychologist (O.D.).

Exclusion criteria were moderate or severe cognitive deficits (defined as Mini-Mental State Examination score ≤21) and dementia, severe depressive and/or anxiety disorders, and psychiatric disorders, all confirmed by neurological, psychiatric, and clinical psychological examination. Further exclusion criteria were other neurological disorders that might impact cognition, confirmed by neurological examination. Physiotherapeutic examination excluded severe orthopedic disorders.

Twenty of 80 participants were excluded. After receiving detailed information about the training program, five individuals refused to take part in the study for various personal and organizational reasons, two were excluded due to severe orthopedic disorder, five for symptoms of severe depressive and anxiety disorders, and eight because of dementia and failure to complete the initial tests.

Sixty participants were enrolled in the study by a member of the research team who was not involved in the assessments or interventions. The project data analyst generated a random sequence of numbers to arbitrarily classify an equal number of participants into groups A and B by means of a computer program. These numbers were placed in an envelope, which was subsequently sealed. The project

manager (Z.O.) opened the envelope and informed participants of their group assignment.

Data were collected in the outpatient psychiatric clinics at two time points. Baseline data were collected before training started and post-training data were collected after 10 weeks of training. Individuals who participated in data collection did not participate in the implementation of the training programs. Participants were informed by the training staff that there were two types of training, but they were not told what intervention they would receive or the anticipated outcomes. The training staff were not blinded.

All participants in group A completed all 20 training sessions. Two participants in group B failed to complete all 20 training sessions due to family problems; they left 2 weeks before completing the training program. Missing values were included in analyses using the principle intention-to-treat, where the last value is carried forward. Participants were given information about the study protocol individually, after which they provided informed consent for participation. The study was approved by the local ethics committee.

Interventions

Both cognitive training interventions were delivered in a psychiatric outpatient clinic by a team comprising a psychiatrist, clinical psychologist, and professionally trained physiotherapist.

Group A used the CogniPlus program. The sub-programs used were designed specifically for individuals with MCI. The training programs are listed with recommendation strength A in the Society for Neuropsychology's (2009) guidelines (Miller, 2009).

The sub-programs that involved activities that are similar to everyday activities were selected, targeting attention, working memory, long-term memory, planning of everyday activities, and visual-motor abilities. The five CogniPlus sub-programs used were:

- Alert (two forms): targets attention. Involves driving a virtual car and stopping as quickly as possible in front of an obstacle (18 levels of difficulty).
- Nback: targets working memory. Participants were shown various pictures and had to remember two to three pictures previously presented (15 levels of difficulty).
- Names: targets long-term memory. Trains participants to use effective strategies for recalling the names and surnames of individuals based on their faces (17 levels of difficulty).
- Pland (three forms—A, B, C): targets executive functions and planning of daily activities. Training consists of solving tasks under time constraints and with some temporal overlap between tasks (16 levels of difficulty).
- Vismo: targets visual-motor abilities. Training involves trying to keep a spaceship displayed on the computer screen inside a circle (22 levels of difficulty).

Training is designed to be progressive. At the start of the program, participants tackled the lowest level of difficulty; the level of difficulty was automatically adjusted thereafter according to individual performance. The objective was to attain the highest level of difficulty on all programs.

Participants quickly attained the highest level of difficulty on the Alert, Names, and Pland A, B sub-tasks and so these were combined with physical exercises to create dual-task conditions. These conditions were not possible for Nback, Vismo, and Pland C, as participants' full attention was required for these tasks.

The dual-task conditions were as follows:

- Alert + exercise (targets attention). Involves driving a virtual car and stopping as quickly as possible in front of the obstacle, while stepping from one foot to the other and raising the heels while standing on both feet.
- Names + exercise (targets long-term memory). Involves memorizing names and faces while changing from a standing position to a one-legged kneeling position and back again.
- Pland A + exercise and Pland B + exercise (targets executive functions). Training involved planning everyday activities and solving tasks within a time limit while taking one step backward and then one step forward.

The training sessions were supervised by a professionally trained clinical psychologist and physiotherapist. The CogniPlus program provides feedback on the level of difficulty the participant has mastered in each task, reaction times, and percentages of correct and incorrect responses. All training sessions lasted 30 minutes; each sub-program lasted 10 minutes and thus all functions were covered in every week of training. Each participant attended two training sessions per week for 10 weeks, with 20 sessions in total.

Group B received the classical group cognitive training program for older adults with MCI (Walsh, 2005). The group was divided into three groups of 10 participants. Training was delivered in two 30-minute training sessions per week for 10 weeks. The training sessions were guided by a trained psychologist. The training comprised exercises targeting the following functions:

- Verbal fluency. Participants read lists of 20 words (with animals, names, objects) written on paper and then had to recall as many as possible for 1 minute.

- Memory. Participants attempted to memorize various short verses; the aim was to remember at least several phrases.
- Psychomotor learning. Participants assembled puzzles to improve their fine psychomotor skills; the aim was to complete various pictures.
- Communication and reasoning. The groups held free discussions on various topics (e.g., family, international and domestic policy, the weather) to encourage participants to express their views and practice their communication skills (Walsh, 2005).

This program did not involve progressive increases in the level of difficulty of the tasks. Performance on the tasks was evaluated subjectively by a therapist. Participants were given information about the program, its aims, and tasks by a trained therapist.

The main differences between the two types of training were as follows:

- CogniPlus (group A) was computer-based and delivered individually, whereas the classical cognitive training (group B) was delivered in a group format, in a more playful style, and offered more opportunities for interaction.
- CogniPlus included dual-task conditions created by adding physical tasks to the cognitive tasks.
- Feedback in CogniPlus was provided by computer, whereas in the classical program the only feedback was subjective feedback from the researchers involved in delivering the program.
- CogniPlus placed heavier demands on attention.

At the end of formal training, participants were instructed to continue performing similar cognitive activities as part of their everyday activities.

Outcome Variables

Variables were assessed at baseline and after 10 weeks of training in all participants. The duration of the training programs was set at 10 weeks because the recommended duration for this type of training is 2 to 3 months (NICE & SCIE, 2011); this timeframe was also believed to be convenient for participants.

The variables selected were designed to provide assessments of cognitive and psychomotor abilities and functional activity and QOL. The methods to assess cognitive and psychomotor abilities were selected because they are frequently used in cognitive psychology and recommended by NICE (NICE & SCIE, 2011). The timing of assessments was similar to that in other studies (Halvarsson et al., 2011; Hiyamizu, Morioka, Shomoto, & Shimada, 2011; Niu, Tan, Guan, Zhang, & Wang, 2010).

Primary Outcome Variables. The Functional Activities Questionnaire (FAQ) is a 10-item self-reported questionnaire used to evaluate functional activities. It assesses an individual's ability to perform the following activities: completing forms, shopping, playing complex social games, preparing meals, following and understanding events, remembering important dates, and orienting oneself to the surrounding environment. Low scores indicate better functioning. The questionnaire is suitable for use in older adults with MCI; it is valid, reliable, and responsive to changes over time (Bartoš, Martínek, Bezdícek, Bucek, & Rípová, 2008; Pfeffer, Kurosaki, Harrah, Chance, & Filos, 1982).

Spitzer et al.'s (1981) QOL index is a 5-item, self-reported index, which assesses an individual's self-sufficiency with respect to daily activities as well as well-being, satisfaction, mood, and provision of support by family or the community. The index comprises five questions with a maximum score of 10. Higher scores indicate better QOL (Spitzer et al., 1981). This validated and reliable index was chosen because of its simplicity, clarity, and comprehensiveness (Erridge et al., 2005; Greimel, Thiel, Peintinger, Cegnar, & Pongratz, 2002).

Secondary Outcome Variables. Addenbrooke's Cognitive Examination (ACE) is a widely used neuropsychological test that provides a detailed cognitive profile of the individual and is used for early detection of cognitive disorders. The ACE comprises five subscales dealing with different cognitive domains: attention and concentration (18 points), memory (26 points), verbal fluency (14 points), language (26 points), and visuospatial ability (16 points). Subscale scores are summed to provide a total score (maximum = 100). Scores between 89 and 100 are considered normal, scores from 83 to 88 indicate mild dementia, and scores <83 indicate severe dementia (Bartoš, Raisová, & Kopecek, 2011; Mathuranath, Nestor, Berrios, Rakowicz, & Hodges, 2000).

The Stroop Test is frequently used to assess attention. The test is presented in the form of three lists: (a) 100 words printed in black, (b) 100 colored rectangles, and (c) 100 words printed in various colors. Response latencies and errors in naming the colors and words are calculated; shorter response latencies and fewer errors indicate better performance. The Words category (participant reads words printed in black as quickly as possible) assesses personal speed. The Colors category (participant names the color of rectangles as quickly as possible) assesses perception. The Words-Colors category (participant

must state the color in which a word is printed as quickly as possible) assesses perception load score. The Words–Colors–Words (participant names the color in which a word is printed and reads the word as quickly as possible) assesses increased load score. When print color and word are congruent (e.g., red printed in red) the task is easy, but when the print color and word are incongruent (blue printed in red), participants experience interference and the task is more difficult (Daniel, 1983; Stroop, 1935).

Descriptive Instruments

The following instruments were used to indicate inclusive and exclusive criteria of potential participants. The MMSE is a valid and reliable 30-point questionnaire that is used in clinical and research settings to assess basic cognitive functions (Folstein, Folstein, & McHugh, 1975). The Beck Depression Inventory (BDI-II) evaluates symptoms of depression, with higher scores indicating more serious depression; the maximum score is 63 points (Beck, Steer, Ball, & Ranieri, 1996).

Statistical Analysis

The primary analysis was intention-to-treat and involved all participants. Descriptive and inferential statistics were used to analyze the data. Independent *t* tests for continuous variables and chi-square tests for categorical variables were used to compare the groups at baseline. Shapiro-Wilk and D'Agostino-Pearson tests were used to confirm that the data were normally distributed. The differences between group A and group B at the time before (i.e., Time 1, baseline) and 10 weeks after the intervention (i.e., Time 2, follow up) were evaluated using general linear model (GLM)–repeated measures (mixed design analysis of variance, split–plot) with Greenhouse-Geisser correction. Effect sizes (*r*) were based on Cohen's *d* using means and standard deviations. Missing values at follow up ($n = 2$) were imputed by the last observation. Calculations were performed using SPSS 22 for Windows. The level of statistical significance was set at $p < 0.05$.

A priori power analysis with *t* test for the difference between two independent means (two groups), with $\alpha = 0.05$, $\beta = 0.2$, and effect size = 0.65, showed that the sample of 30 participants in each group was sufficient, with an actual power of 0.80.

RESULTS

Demographic and Baseline Characteristics

The demographic profile of the sample is summarized in **Table 1**. The sample comprised individuals with MCI ages 65 to 75. Groups A and B were similar with respect to age, education, and duration of MCI. BDI-II scores indicated mild depression and MMSE scores indicated mild cognitive deficit.

Post-Training Means and Group Comparisons

Table 2 presents the pre- and post-training results among the sample. There were no baseline differences between groups, and no differences in functional activities were found after training. QOL was better in group A ($p < 0.001$) after training. The effect size was medium ($r = 0.69$).

After training, group A had higher total ACE scores ($p < 0.001$), with a small effect size ($r = 0.31$). Group A also had a better score on the language subscale (i.e., items relating to comprehension, writing, naming of objects, reading) ($p < 0.01$), with a medium effect size ($r = 0.76$). There were no group differences on the other subscales (i.e., memory, attention and concentration, verbal fluency, visuospatial abilities).

After training, group A performed better on the Stroop attention tasks: increased load score was higher ($p < 0.05$) and participants made fewer mistakes ($p < 0.001$). Effect sizes were small (load score, $r = -0.23$; errors, $r = -0.47$). There were no group differences for the other attentional variables (e.g., personal speed, perception factor, perception load score).

DISCUSSION

The current study compared two cognitive training programs designed for older adults with MCI. The aim was to determine the degree to which skills learned during training transferred to functional activities and improved QOL. The main finding was that the CogniPlus program produced a larger improvement in QOL and overall cognitive functioning (as measured by total ACE score) and attentional functioning (increased load scores and fewer errors on a Stroop task) than classical group-based cognitive training. This finding may be because the CogniPlus program is more complex and makes heavier demands on attention, as well as offers the opportunity to create dual tasks by combining tasks with physical exercises.

There were no post-training group differences in functional activities, which might be due to the assessment method used. One review (Bheher, 2015) concluded that there was limited transfer effect from cognitive training to functional activities, and the current study corroborates this finding.

TABLE 1

Demographic and Baseline Characteristics of Participants (*N* = 60)

Demographic/Characteristic	*n* (%)		*t* test/χ^2 test	*p* Value[a]
	Group A	Group B		
Gender				
Male	12 (46)	17 (51)	1.66	0.30
Female	18 (54)	13 (49)		
Education level				
Secondary	25 (75)	26 (78)	0.75	0.45
University	5 (25)	4 (22)		
	Mean (*SD*)			
Age (years)	67.8 (6.5)	68.2 (4.2)	–0.28	0.78
MMSE score[b]	25.6 (2.41)	24.9 (2.52)	1.09	0.27
Duration of MCI (months)	17.07 (7.82)	16.87 (6.42)	0.10	0.91
BDI-II score[c]	17.47 (8.42)	17.93 (6.25)	–0.24	0.80
Primary outcome measures				
FAQ[d]	4.80 (2.57)	4.73 (2.44)	0.10	0.91
Spitzer QOL[e]	6.90 (1.29)	7.13 (1.19)	–0.72	0.47
Secondary outcome measures				
Addenbrooke's Cognitive Examination[f]				
Total score	77.9 (9.9)	76.37 (7.45)	0.67	0.50
1. Attention and concentration	15.93 (1.50)	15.87 (2.12)	0.14	0.88
2. Memory	15.67 (4.22)	16.97 (2.38)	–1.46	0.14
3. Verbal fluency	9.13 (2.63)	10.43 (3.56)	–1.60	0.11
4. Language	22.73 (3.49)	20.37 (3.44)	0.12	0.06
5. Visuospatial	13.87 (2.72)	12.33 (2.17)	0.11	0.06
Stroop Test				
Words—personal tempo, time (s)	83.25 (29.64)	81.36 (35.98)	0.22	0.82
Colors—perception factor, time (s)	88.33 (37.87)	85.56 (37.98)	0.28	0.77
Words–colors—perception load score, time (s)	95.75 (32.76)	99.83 (48.65)	–0.38	0.70
Words–colors–words—increased load score, time (s)	209.07 (66.85)	209.47 (54.16)	–0.02	0.98
Errors—number	12.67 (6.82)	13.37 (5.59)	–0.43	0.66

Note. MMSE = Mini-Mental State Examination; MCI = mild cognitive impairment; BDI = Beck Depression Inventory; FAQ = Functional Activities Questionnaire; QOL = quality of life.

[a] *p* values are based on independent *t* test for continuous and chi-square test for categorical variables.

[b] Scores ≤21 indicate moderate to severe cognitive deficits.

[c] Maximum score is 63, with higher scores indicating greater depression.

[d] 10 items, lower scores indicate better functioning.

[e] Maximum score is 10, with higher scores indicating better QOL.

[f] Maximum score is 100, with 89 to 100 = normal, 83 to 88 = mild dementia, and <83 = severe dementia.

Group A reacted positively to computerized performance feedback, which was presented in a graphic format and explained to participants by the therapist. This positive reaction may have contributed to an improvement in well-being and higher QOL reported for group A. Participants in group B tended to compare themselves to other members of their training group, which was not always encouraging and may have had a negative impact on well-being.

Zimmermann et al. (2014) compared CogniPlus training with non-cognition-specific computer sports

TABLE 2

Mean Scores and Statistical Comparison of Interventions Before (T1) and After (T2) Training (10 Weeks)

Measure	Group	EMM (*SD*)				Effect Size	
		T1–Baseline	T2–Follow Up	F	*p* Value[a]	*r*	Interpretation[b]
Primary outcome measure							
FAQ	A	4.80 (2.57)	4.26 (3.41)	0.06	0.79	0.03	No effect
	B	4.73 (2.21)	4.03 (2.67)				
Spitzer QOL	A	6.90 (1.29)	9.56 (1.00)	160.95	0.001	0.69	Medium
	B	7.13 (1.22)	7.25 (1.35)				
Secondary outcome measure							
Addenbrooke's Cognitive Examination							
Total score	A	77.90 (9.99)	85.63 (8.22)	7.64	0.008	0.31	Small
	B	76.37 (7.67)	80.52 (7.30)				
1. Attention and concentration	A	15.93 (1.50)	17.50 (2.77)	1.05	0.31	0.08	No effect
	B	15.87 (2.16)	17.10 (1.79)				
2. Memory	A	15.67 (4.22)	17.33 (4.55)	0.07	0.78	–0.09	No effect
	B	16.97 (2.39)	18.75 (9.27)				
3. Verbal fluency	A	9.13 (2.63)	10.00 (6.49)	0.13	0.72	–0.09	No effect
	B	10.43 (3.56)	11.46 (8.84)				
4. Language	A	22.73 (3.49)	25.50 (1.13)	18.64	0.01	0.76	Medium
	B	20.37 (3.56)	18.64 (3.88)				
5. Visuospatial	A	13.87 (2.72)	15.30 (1.68)	1.91	0.17	0.09	No effect
	B	12.33 (2.11)	14.57 (4.98)				

games. The sports game training produced greater improvements in attention than the CogniPlus training. Zimmermann et al. (2014) suggested that this result might have been due to the motion element in the sports game training. The current researchers assumed that the motion elements performed as dual tasks could have a significant impact on improving attention. Therefore, motion elements were incorporated into physical exercises to create dual-task conditions in the easily manageable subprograms from CogniPlus tasks. The results showed that this made CogniPlus more effective as a tool for improving attentional functioning and QOL. Zimmermann et al. (2014) did not evaluate transfer of training effects to QOL.

Vidovich et al. (2015) examined group cognitive activity and nonspecific educational programs in 160 older adults with MCI with a 2-year rate of cognitive decline. Interventions lasted 5 weeks. They found only small beneficial effects on attentional functioning and QOL. Although the current study's assessment schedule was 10 weeks, the group B findings are consistent with Vidovich et al.'s (2015) results.

STRENGTHS, LIMITATIONS, AND RECOMMENDATIONS

The strengths of the current study include a relatively high response rate (85%) and low drop out rate. The main limitations of the study were the small sample and participants were only monitored for a short period of time. The longer-term impact of interventions on variables was not examined. In addition, a control (i.e., no intervention) group was not included; therefore, the general effect of training could not be determined. Future studies with longer-term follow up are necessary. It would be appropriate to determine which aspects of QOL were most affected by the completion of cognitive training using other validated questionnaires.

CLINICAL IMPLICATIONS

Based on the current results, the design of cognitive training programs should be improved and other dual-task training needs to be developed. Nurses can contribute to the development and activation of new programs with dual tasks for older adults with cognitive deficits, as well as long-term monitoring of the transfer of interventions to concrete domains of QOL of older adults.

CONCLUSION

CogniPlus combined with motion elements produced greater improvements in QOL, overall cognition as assessed by total ACE score, and attentional functioning (higher load scores and fewer errors on a Stroop task) than a classical group-based cognitive training program. However, the transfer to functional activities was no better than the group-based classical cognitive training program.

TABLE 2 (CONTINUED)

Mean Scores and Statistical Comparison of Interventions Before (T1) and After (T2) Training (10 Weeks)

		EMM (*SD*)				Effect Size	
Measure	**Group**	**T1–Baseline**	**T2–Follow Up**	**F**	***p* Value[a]**	***r***	**Interpretation[b]**
Stroop Test							
Words—personal tempo, time (s)	A	83.25 (29.64)	63.75 (23.09)	3.89	0.06	–0.04	No effect
	B	81.36 (25.45)	66.10 (32.03)				
Colors—perception factor, time (s)	A	88.33 (37.87)	67.84 (20.36)	0.57	0.45	0.05	No effect
	B	85.56 (32.42)	64.92 (30.64)				
Words–colors—perception-load score, time (s)	A	95.75 (32.76)	83.06 (29.03)	0.23	0.62	–0.07	No effect
	B	99.83 (48.51)	89.03 (48.54)				
Words–colors–words—increased load score, time (s)	A	209.07 (66.85)	162.36 (49.47)	5.89	0.05	–0.23	Small
	B	209.47 (55.48)	183.96 (39.08)				
Errors—number	A	12.67 (6.82)	2.73 (6.03)	15.80	0.001	–0.47	Small
	B	13.37 (5.43)	12.03 (10.77)				

Note. EMM = estimated marginal means; FAQ = Functional Activities Questionnaire; QOL = quality of life.
[a] Based on mixed-design analysis of variance.
[b] Small 0.2; medium 0.5; large 0.8.

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