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CREC: The Role of Serious Games in Improving Flexibility in Thinking in Neuropsychological Rehabilitation

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Complete List of Authors:	Colautti, Laura; Universita Cattolica del Sacro Cuore Facolta di Psicologia, Psychology Baldassini, Davide; Istituto di Tecnologie Industriali e Automazione Consiglio Nazionale delle Ricerche Colombo, Vera; Istituto di Tecnologie Industriali e Automazione Consiglio Nazionale delle Ricerche Mottura, Stefano; Istituto di Tecnologie Industriali e Automazione Consiglio Nazionale delle Ricerche Sacco, Marco; Istituto di Tecnologie Industriali e Automazione Consiglio Nazionale delle Ricerche Sozzi, Matteo; Casa di Cura del Policlinico Spa, Neuro-Rehabilitative Sciences Corbo, Massimo; Casa di Cura del Policlinico Spa, Neuro-Rehabilitative Sciences Rusconi, Maria Luisa; Universita degli Studi di Bergamo, Human and Social Sciences Antonietti, Alessandro; Universita Cattolica del Sacro Cuore Facolta di Psicologia, Psychology
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Structured practitioner notes

What is already known about this topic

- Flexibility is a component of creative thinking and it is present in every stage of life, even in people with cognitive impairment or neurological deficits.
- Flexible thinking is fundamental for the solution of everyday problems and for adapting to one's own living environment.
- Existing training programs aimed at enhancing flexible thinking show some limits, such as the lack of structured plans of activities and specific goals.
- Moreover the largest part of training programs applied in cognitive rehabilitation are not focused on daily problems, nor let the patient to get functional strategies to solve them.

What this paper adds

- The training program described here has a specific theoretical basis, shows a well defined structure, and includes different types of activities.
- Activities are aimed to improve flexible thinking in everyday life, with a particular attention to lead patients to acquire strategies to face daily problems.
- The innovative aspects of this training program include the support of the technology to create situations similar to the patient's everyday context.

Implications for practice and/or policy

- Findings showed that it is possible to connect flexible thinking to neuropsychological rehabilitation.
- The training program can be implemented to lead patients to perceive themselves as competent in facing daily challenges and to be motivated to cope with everyday problems.
- The training program can contribute to increase patients' quality of life and improve their emotional states.
- Patients can learn to generate original ideas and break rigid response patterns.

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[1]Colautti L., [2]Baldassini D., [2]Colombo V., [2]Mottura S., [2]Sacco M., [3]Sozzi M., [3]Corbo M., [4]Rusconi M. L. and [1]Antonietti A.

[1]*Department of Psychology, Catholic University of the Sacred Heart, Milan, Italy*
[2]*ITIA (Institute of Industrial Technologies and Automation), CNR (National Research Council), Milan, Italy.*
[3]*Department of Neuro-Rehabilitative Sciences, Neuropsychology Unit, Casa di Cura del Policlinico, Milan, Italy*
[4]*Department of Human and Social Sciences, University of Bergamo, Italy*

Colautti, Laura: Graduated in "Psychology for Well-Being: empowerment, rehabilitation and positive technology" at the Catholic University of the Sacred Heart in Milan. She is currently engaged in an internship in the field of neuropsychological assessment and rehabilitation.
Baldassini, Davide: Graduated in Biomedical Engineering at Politecnico di Milano, Milan, Italy. Early Stage Researcher at ITIA-CNR working in Enterprise Engineering and Virtual Applications division. His research activities focus on virtual reality-based systems and their application in rehabilitation and assisted living fields for promoting health and well-being.
Colombo, Vera: Graduated in Biomedical Engineering at Politecnico di Milano, Milan, Italy. Early Stage Researcher at ITIA-CNR working in Enterprise Engineering and Virtual Applications division. Her research activities focus on virtual reality-based systems and their application in rehabilitation and assisted living fields for promoting health and well-being.
Mottura, Stefano: Researcher at ITIA-CNR in Enterprise Engineering and Virtual Applications division; His activities are focused in virtual reality systems for virtual factory and for supporting rehabilitation.
Sacco, Marco: Senior Researcher at the Institute for Industrial Technologies and Automation of the National Research Council of Italy in Milan,where he is the head of Enterprise Engineering and Virtual Applications. He is also President of EuroVR (the European Association of Virtual Reality and Augmented Reality).
Sozzi, Matteo: Head of Neuropsychology Unit, Department of Neuro-Rehabilitative Sciences, Casa di Cura del Policlinico, Milan, Italy.
Corbo, Massimo: Scientific Director, Casa di Cura Privata del Policlinico, Milan, Italy.
Rusconi, Maria Luisa: Full professor of Neuropsychology at the University of Bergamo.
Antonietti, Alessandro: Full professor of Psychology at the Catholic University of the Sacred Heart in Milan, where he is the head of the Cognitive Psychology Laboratory and of the Research Center for Vocational Guidance and Socio-Professional Development.

laura.colautti01@icatt.it, davide.baldassini@itia.cnr.it, vera.colombo@itia.cnr.it, stefano.mottura@itia.cnr.it, marco.sacco@itia.cnr.it, m.sozzi@ccppdezza.it, m.corbo@ccppdezza.it, marialuisa.rusconi@unibg.it, alessandro.antonietti@unicatt.it

Abstract

An exploratory study aimed at testing CREC, a training program designed for people with cognitive impairments caused by a stroke, is reported. The goal of the programme is to improve flexibility in thinking through a creative approach based on everyday problems. The programme includes two Serious Games (SGs) developed ad hoc, dealing with the transfer of the learned strategies to the home environment. The training was applied to six patients to test if it could bring beneficial effects to them. Before and after the training, patients' neuropsychological functioning, emotional state, and level of creativity were assessed. Results showed improvements in memory, logical reasoning, and praxic skills. Improvements in quality of life and in creativity emerged as well. At the end of the training the patients perceived themselves as more efficient in problem-solving and recognised that the SGs led them to reflect critically on some aspects of their daily life that they usually took for granted.

Keywords: creativity, cognitive impairment, cognitive rehabilitation, flexibility, problem-solving, serious game

1. Introduction

Flexibility in thinking is the ability to adopt different perspectives when approaching a situation in order to find new ways to handle it. Flexibility in thinking is considered a component of creativity (Guilford, 1959) and a form of functional problem-solving (Sternberg, 2006). It plays an important role in everyday life, especially in facing daily challenges. It is regarded as the ability to interact with the environment, discarding predictable solutions and developing alternative behaviours which are appropriate to the context. If this ability is not properly trained, however, it may decrease (Antonietti et al., 2013). Other causes of such decrements can be aging or the onset of neurological conditions such as Alzheimer or Parkinson diseases and stroke. These conditions can lead patients to implement stiff and stereotyped environmental response schemas, often reflective of the behaviour displayed before the morbid event, but which do not take into account that situations may change from time to time (Grossman, 1988; Kleiner Fisman et al., 2003).

Several studies have shown that creativity is present at every stage of life, including in elder people (Leon et al., 2014; Price & Tinker, 2014). It is also noticeable in people with neurological conditions and can give rise to a better adaptation to their conditions (Crutch et al., 2001). As a matter of fact, the cognitive reserve keeps changing with new experiences. Creative exercises could increase this capacity with flexible and effective strategies; they are thus useful in delaying and coping with cognitive decline (Liberati et al., 2012). Direct brain stimulation can enhance creative potential as well (Colombo et al., 2015).

Flexible thinking could be fostered to improve the independence and quality of life of neurological patients (Kowatari et al., 2009) and to enable them to surmount maladaptive and predictable response patterns (Fisher et al., 2000). For this reason, it is important to focus on problems and obstacles that weigh upon people addressed by the training, giving them instruments for finding new, more adaptive solutions. This paper shows a possible way to improve flexibility in thinking, to enable post-stroke patients to solve daily challenging situations.

Some training programmes are currently available to patients with cognitive impairments due to cerebral lesions. The Reality Orientation Training (ROT; Holloran et al., 1997) is based on paper-and-pencil exercises and is divided into eight areas (spatial-temporal orientation, solution of simple problems, abstract reasoning, solution of functional problems, information management, inferences in daily situations, functional activities). Problem-solving in daily situations involves anticipation of effects or identifying causes and ways to cope with problems. However, in this training the patient is not required to find alternative and flexible solutions that could be useful due to his/her changed health condition. Moreover, the patient is not asked to think about the consequences the solutions could produce for other people. Other more recent tools in the Italian context are the training called 'Una palestra per la mente' ('A gym for the mind') (Ferrari et al., 2011) and 'Training di riabilitazione cognitiva' ('Cognitive rehabilitation training') (Powell et al., 2009). The first application is divided into six areas (temporal orientation, spatial orientation, visual attention, memory, language, logic). Each area is based on daily stimuli (e.g., the organisation of a calendar, identification of objects, recalling pre-learnt notions). However, the whole programme is addressed to patients with severe cognitive impairments, but not to patients with global cognitive functioning in the standard range, as is the case of post-stroke patients. The second training is divided into three areas (memory, thinking ability, executive functions) and, as with the previous one, is based on daily stimuli. However, alternative ways to solve daily problems are not considered and only one correct solution is required. Hence, a limit of these training programs emerges: patients are not

encouraged to find, on their own, functional strategies to produce alternative solutions useful in their everyday life. Moreover, specific sessions aimed at improving reasoning about more appropriate behaviour are not included. Patients who have residual impairments in flexibility in thinking, after finishing their rehabilitation programme during the hospitalisation period could encounter obstacles when they return home (namely, into an environment that is not shielded as the previous one). They would not necessarily have the strategies to cope with such issues, as they did in the hospital.

More specific technological tools can be used in rehabilitation to improve flexibility in thinking, but they are not focused on daily problems. For example, ERICA (Inzaghi, 2013) is a computer program divided into five areas (attention, spatial cognition, memory, verbal executive functions, non-verbal executive functions). However, not even this program is geared towards fostering flexibility and problem-solving abilities in order to face daily problems. Some tools focused on such abilities are based on virtual reality, a technological device which cannot easily be managed with neurological patients. For instance, Gamito and colleagues (2015) used virtual reality to propose different types of daily life activities implicating working memory (buying target items), visuospatial orientation (finding different shops), selective attention (finding target stimuli among distractors), recognition memory (recognising elements), and calculation (digit span retention). Exercises, however, are mostly focused on logical thinking and do not encourage flexibility in thinking. In addition, these kinds of tools are expensive and based on a type of technology that not all hospitals can financially afford.

2. The Training

Cycles of traditional rehabilitation usually fail to produce any effect in patients who both have reached a 'roof effect' with traditional cognitive rehabilitation and also have residual impairments, especially in executive functions. Thus, in these patients it is necessary to stimulate flexibility in thinking, which is fundamental for every daily activity, in other ways. To our knowledge no other structured training used in cognitive rehabilitation addresses such a goal. CREC ('Creativity in Everyday-Life Challenges') has been designed and implemented with this purpose, namely, with the aim of improving flexibility in thinking by providing creative tasks.

2.1. Structure

CREC is a training programme designed to improve flexibility in thinking and adaptability in daily life in post-stroke patients. CREC is focused on eliciting the three mental operations that underlie creative thinking according to the WCR Model (Antonietti & Colombo, 2013, 2016): Widening patients' point of view, making them aware of the great number of elements that characterise a given situation; Connecting elements and combining ideas in uncommon ways; Reorganising one's mental field and thus changing one's perspective.

The training is organised into five units, each of them focusing on a problematic situation of daily life (relevant to the majority of stroke patients): (1) waiting for something desired; (2) dealing with the damage of a necessary tool; (3) interacting with someone not appreciated by the patient; (4) finding successful strategies to cope with memory problems; and (5) planning some activities with others by taking into account their needs. The units are designed to be implemented sequentially. Each unit is characterised by various activities, with the same structure and sequence of presentation, but varying in contents. Activities start from exercises offering immediate feedback about the strategy found and gradually move to autobiographical and daily topics. This is designed

to accustom the patient to analysing a situation before acting and finding the strengths and weaknesses of the possible approaches.

In detail, the first step consists of praxic exercises, to be carried out with objects of different nature, with the aim of explaining to the patient that there are various ways to cope with a problem. The second step consists of some strange and paradoxical situations that could happen in the real world under particular conditions. The patient must discover why these conditions occur by moving away from the more automatic answer that may come to his/her mind. The next step concerns fictitious news or short movies, displayed on the screen of a laptop or tablet, related to the problematic area addressed in the unit. The aim is to show unconventional and functional solutions and present them from unusual points of view. Afterwards the patient is asked to remember and describe similar past situations that occurred in his/her life and how he/she faced them. The fifth step is composed of the SGs module, which thus far has been created for two units. The use of a tablet or a laptop is also provided for this type of activity.

2.2. The Activities

2.2.1. The Praxic Exercises

For the first activity there are three types of work materials: 12 plastic cubes, nine letter shapes, and 24 magnetised bars together with 12 steel spheres. One of these kinds of materials is used per session. The patient is asked to construct buildings as high as he/she can or shape the outline of some objects. The instructions are given four times. When asked to create the outlines of objects, the patient must create objects belonging to different categories. Execution time is recorded. The aim of these types of activities is to stimulate praxic abilities to improve problem-solving skills, flexibility in thinking, abstraction, and categorisation. Executive functions—especially planning, monitoring, and control of specific goal-oriented actions—are involved as well. Another important aim is to focus the patient on possible functional strategies to think in different ways and to find more than one solution.

2.2.2. The Paradoxical Situations

The second step stimulates the ability to generate more than one response to understanding and transforming the described scenario. In this manner patients are prompted to follow other functional ways of thinking and apply the strategies they discovered in the previous activity.

2.2.3. The News and Movies

The third step concerns reading short news stories or looking at a movie segment. All the material is relevant to the problematic area of the unit in question. Two pieces of news and one short video are scheduled for each unit. The aim of the news is to lead patients to reflect in a critical way on the situation described, look for possible problems that may arise from what it has been read, and find many possible solutions by applying the functional strategies already found. The goal of the movies is to observe and analyse the solutions applied by the protagonist and find other ways to face the situation by taking into account the resources and limits of the protagonists.

2.2.4. The Patient's Similar Past Situations

The fourth step asks patients to evoke a problematic autobiographic event, similar to the issue discussed in the unit. In this manner the patient must report a specific situation and how he/she coped with the problem and as well, consider if it could be managed in a functional way.

2.2.5. The SGs

Two SGs, developed ad hoc and named 'Trip' and 'Party' were included in the training. They are designed to be offered, respectively, at the end of Units 2 and 5. Their content is linked to the topics

of these units. They are directed towards transferring the strategies learned during the previous activities of the unit to the home environment. This allows the patient to derive concrete examples and connections with daily situations, thereby encouraging autonomy in the domestic context. As are the other activities of the training, the games are based on the WCR model with respect to the mental operations they are intended to stimulate (widening one's point of view, connecting different mental fields, and reorganising the changed perspective). In both games there is a list of 10 objects and a table with 16 objects placed on it. The patient must select the objects on the table that are included on the list in order to implement a personal solution strategy. On the table there are four visible objects that are named in the list (standard objects); six objects not in the list, but their function can be altered, given uncommon ways of using them (creative objects); and six objects used as distractors, since they do not allow patients to reach the goal (Figure 1). For each game there is only one level of difficulty. The patient selects the objects by clicking on them. If the selected object is correct, it disappears from the table and is placed near its name on the list with a check mark. If the patient chooses a distractor object, an error is counted. To avoid frustration, no feedback is provided during the game. The patient can ask for help, if needed, by clicking on an item of the list. Immediately a message appears. Three levels of facilitation are provided: The first is an encouraging message, the second gives notions about the principal function of the required object, and the third reminds the patient of the three functional requirements.

Fig. 1: The initial screen of the "Party" SG. Green circle: standard object, blue: creative objects, yellow: distractor objects.

Before the start of each game the patient is asked to read the instructions on how to play the game and how to ask for facilitations. When the game is completed, data about his/her performance (number of errors, facilitations requested, order of selection of objects, playing time) are stored and available to the therapist. At the end of each game only the correct objects selected are visible on the table, so that the therapist can reason with the patient, emphasising the decisions made and the problem-solving strategies which have been used.

3. An Application

The aim of the training programme was to increase flexibility in thinking in patients' daily lives. Improvements in quality of life, emotional states, and creativity level were expected as well. In particular, it was expected that patients would acquire strategies that, at the end of the training, they would also use in their everyday lives. A pilot study was initially carried out to obtain preliminary data about: the level of acceptance of the training activities by the patients; feedback about the level of difficulty and adequacy of the proposed exercises; how much time was needed to complete the tasks included in the training; and the degree of originality of the responses.

3.1. Sample

The whole training has been tested on six post-stroke patients (five men and one woman; age range: from 53 to 73 years; M = 60.17, SD = 7.47) with heterogeneous injured brain areas (Table 1). All patients had suffered an ischemic event at least one year earlier, to avoid possible spontaneous

improvements. The inclusion criteria were: age over 50 years, MMSE > 22/30 (Folstein et al., 1975), and stable clinical picture. The exclusion criteria were: presence of oncological and/or psychiatric diseases, presence of severe focal neuropsychological impairments (e.g., aphasia or neglect), or presence of deep cognitive impairment. During the training period patients did not undergo other neuropsychological rehabilitation treatments. Only patients who had already been engaged in cognitive rehabilitation cycles, and thus were expected to have no further improvement with traditional rehabilitation, were chosen.

ID	Gender	Age (yrs)	Schooling (yrs)	Computer familiarity*	Marital status	Employment	Type of ischemic event	Year of the event
MC	m	56	13	yes	married	bank employee	left lesion: thalamic ischemic stroke	2015
LM	m	73	8	no	married	retired (technical expert)	left lesion: occipital ischemic stroke	2015
GS	m	65	8	no	married	retired (school caretaker)	left lesion: cerebral hemorrhage intraparenchymal thalamus/capsular	2011
GS	m	58	13	no	married	bank manager	vasculopathy supraortic trunks	2016
MB	m	53	17	yes	married	electrical engineer	post anoxic cerebropathy	2015
PC	f	56	8	no	married	restaurant manager	right lesion: sub arachnoid hemorrhage	2011

Tab. 1: Patients' data
* regular use of computer (at least five times a week)

3.2. Assessment

3.2.1. Neuropsychological Tests

A wide set of tests—listed in the Supplementary materials—were administered to assess patients' levels of cognitive functioning.

3.2.2. Affective States Tests

Depression, anxiety, apathy, and quality of life were assessed by means of the instruments listed in the Supplementary materials.

3.2.3. Creativity Tests

The WCR test (Antonietti, Giorgetti, & Pizzingrilli, 2011) is composed of nine items, divided into three subscales (W = Widening, C = Connecting, R = Reorganising) that represent the three mental operations of creativity mentioned above according to the WCR model. Each subscale is comprised of three items. In the first subscale the respondent is asked to select one answer from four options. Two items are visual (the respondent is asked to identify the possible meaning of a drawing) and one is verbal (the respondent is asked to identify the possible use of a given object). In the second subscale the respondent is asked to choose, from a list, three elements which can be associated with the proposed stimuli (two items propose verbal stimuli and one item a visual one, namely, a scene where the respondent must place three objects). In the third subscale the respondent is asked to select, from a list, the consequences of given situations. Two items are verbal and one is visual. No time limits are imposed. Three scores are obtained, one for each subscale. Scores are computed through conversion of the chosen answers into a scale (ranging from 0 to 99) based on reference tables according to the normative sample. The higher the scores, the more original are the respondent's answers.

The Abbreviated Torrance Test for Adults (ATTA; Goff et al., 2002) assesses creative thinking through three activities (one verbal and two visual). Respondents have three minutes to complete each of them. In the first activity the patient is asked to imagine an impossible condition (flying in

the sky without being in an airplane) and to find as many problematic situations as possible which can occur. In the second activity two incomplete figures are shown. The respondent must create drawings by completing them; It is stressed that drawings should be as complete and unusual as possible. The respondent is asked to give a title to each drawing. In the third activity the participant is asked to draw as many figures as possible starting from nine identical triangles. He/she must give a title to each created figure. According to the scoring criteria reported in the manual of the test, responses given in the three activities allow the scorer to obtain the Creative Index (CI), corresponding to the total level of creativity exhibited by the respondent.

3.3 Procedure

The training sessions took place at the Casa di Cura del Policlinico (Policlinic Care Home) in Milan, from March 2017 to July 2017. The whole training is composed of 20 sessions (three per week), as a standard rehabilitative cycle. Each session takes about 60 minutes. A pre-treatment evaluation, including neuropsychological, affective, and creative fields, was scheduled before the beginning of the training. At the end of the training a post-treatment evaluation was carried out. Where possible, in the post-treatment evaluation parallel tests (especially for the neuropsychological evaluation) were chosen, but for the other explored fields (quality of life, emotional states, and creativity) the tests were the same because no parallel tests were available. However, learning effects had to be excluded because patients did not remember the items of the assessing tools administered before. At the end a semi-structured interview about the perceived quality of the training program was administered.

4. Outcomes

At the end of the training, qualitative analyses on neuropsychological pre/post tests showed improvements in different cognitive skills, depending on the patient and the type of impairment each one exhibited. In particular, improvements were observed in memory, praxic skills, and in non-verbal executive functions (in line with the nature of the activities proposed), whereas errors due to impulsiveness remained. Some limits emerged. Not all the patients underwent neuropsychological evaluation after the training, but only a qualitative epicrisis was allowed.

Statistical analyses of emotional states and creative thinking were conducted through a Wilcoxon nonparametric test, assuming as significant a p-value < .10 because of the small number of participants (Table 2).

	Pre-Training		Post-Training		p
	M	SD	M	SD	
MQOL-It	6.56	0.41	7.39	0.64	.075*
BDI	12.67	9.48	8.67	8.43	.216
STAI-X1	52.03	32.40	28.78	27.15	.345
AES	11.17	4.62	10.17	3.31	.465
ATTA-CI	59.00	10.88	67.50	16.55	.046*

WCR-W	51.83	7.11	54.33	8.31	.414
WCR-C	39.53	7.07	39.64	4.96	.893
WCR-R	73.72	7.99	72.78	6.59	.833

Table 2: Mean scores and SDs for emotional states and creativity level in the two phases of the intervention
* $p < .10$

From the comparison between pre- and post-training scores, significant improvements emerged in the perception of quality of life and in the Creativity Index of the ATTA. An improvement in the W scale of the WCR test emerged as well, although it was not statistically significant. In general, patients at the end of the training gave more unusual and original answers. It was therefore assumed they were more likely to generate ideas that were out of the ordinary. Depression levels, anxiety, and apathy also decreased.

In the interview the participants reported to have perceived the training as useful (on a 7-point scale, where 1 = minimum and 7 = maximum: M = 6.12, SD = 0.77). They also reported feeling more competent in problem-solving, with concrete repercussions in their daily activities, such as increased motivation to undertake new activities and start over the abandoned ones of their own will. Patients further reported that during the sessions they perceived positive feelings such as motivation and interest in activities. With respect to the SGs, patients judged them as useful for reflecting critically on aspects of daily life usually taken for granted. Moreover, they recognised that the SGs offered clear instances of possible application and use of flexible thinking in everyday contexts, applied to both concrete objects and common situations.

As for the participants' performance in the games, direct observation of their behaviour during the SGs suggested that the tablets were more functional than the laptops (given the immediateness in tapping objects without the need of a mouse). This was particularly useful for patients with limited arm mobility due to their stroke event. This finding should be kept in mind for future implementations because of the influential role played by body actions in creativity (Andolfi et al., 2017).

5. Discussion and Conclusions

At present most of the training programmes designed to enhance creative thinking have some limits (e.g., lack of specific goals or metacognitive hints). Furthermore, they show limited adherence to the concrete life of the patients (Antonietti, Colombo, & Pizzingrilli, 2011). Moreover, some training interventions geared towards neurological patients are focused on a single kind of activity, for example, writing or drawing. Unlike them, the present training is focused on specific aspects of flexibility in thinking and offers a wide range of activities in order to match different characteristics of the patients to whom it is addressed.

All the patients, at the end of the 20 sessions, reported feeling more competent in coping with problematic situations in their daily life. This subjective perception was supported by an increase in creative skills as reflected on the ATTA and by improvements observed on the neuropsychological assessment. Additionally, patients reported feeling more motivated to engage in activities broken off after their morbid event. These perceptions were mirrored by changes in scores measuring quality of life.

The SGs have been perceived as an aid in linking strategies used during the training to concrete daily situations, supporting the possibility of viewing a known object from different perspectives—a benefit which is crucial also in instructional technological tools (Antonietti et al., 2000; Antonietti et al., 2001). What patients reported is important in that the SGs are not an additional part of the training without connections to other activities. Rather, they appeared to be the 'benchmark' against which what has been learned could be tested (due to the reflections developed in the basis of the other tasks) and applied to a specific everyday-life situation. Thus, they could be considered an essential component of the training, even if they were only one of the five sections comprising it.

This project contributes to a research and applicative area not much explored as yet, linking creative thinking to neuropsychological rehabilitation through the use of technological support. The results appear to be encouraging, with increased positive emotions and perception of competence, as well as improvement in the quality of life and in creative thinking, as a consequence of implementation of the training. On the other hand, the small number of participants suggests caution in generalising the outcomes. Furthermore, in the answers given to the questionnaires, the lack of critical standards of some patients must be taken into account. Future steps would aim at increasing the size of the sample and improving the activities according to what emerged in the first implementation. Another limitation to be overcome in future applications is that, for ethical reasons, it was not possible to have a control group with no cognitive treatment.

Moreover, further SGs for the other units, always keeping the WCR model as a foundation, should be designed, making them relevant to the problematic area into which they should be inserted. The activities for the new SGs would take into account the feedback received from the first patients. In particular, they should concern activities in which the patient has to choose the sequence of relevant tasks to do under temporal pressure. These would be decisions to make after the first impressions elicited and by keeping in mind different notions for various simultaneous tasks, using the strategies the patients found as productive during the training sessions.

Statements on open data, ethics and conflict of interest

The research has been approved by the Ethics Committee for Psychological Research of the Catholic University of the Sacred Heart in Milan. All patients accepted and signed an informed consent before starting the training. The collected data were processed in accordance with the privacy policy. The database can be requested to the corresponding author. The authors confirm that there is no conflict of interest in the work reported.

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Supplementary Materials

Neuropsychological Assessment

Patients were administered the tests listed below.

The Mini-Mental State Examination (MMSE; Folstein et al., 1975) is a short screening test, assessing global cognitive functionality. It is composed of six sections which evaluate spatial and temporal orientation, word registration, attention and calculation, recall language, language and the ability to implement simple commands, and praxic ability.

The Copy of the Rey-Osterrieth Figure (Caffarra et al., 2002), assessing constructive praxis, consists of copying a complex figure.

The Attentive Matrices test (Spinnler et al., 1987) assesses focused attention. It is composed of three matrices, in progressive order of difficulty, where the patient has to select specific numeric targets.

The Trail Making Test (TMT; Reitan, 1958) assesses shifting attention. In the first part of the task the patient must connect numbers and alphabetic letters in an alternated progressive order.

The Raven's Progressive Matrices (Spinnler et al., 1987) assesses abstract reasoning ability through visual geometric stimuli.

The Verbal Fluency test (Novelli et al., 1986) assesses ideational flexibility. It is composed of two parts: phonemic and categorical items.

The Stroop test (Caffarra et al., 2002) assesses the inhibitory ability in presence of interference stimuli. It is composed of three parts, in which the patient must read the names of colors, name the colors of some circles, and name the colors of the ink of some names of colors.

The Wisconsin Card Sorting test (Laiacona et al., 2000) assesses flexibility. Patients must pair 60 cards below four key-cards in accordance with the examiner's feedback, which depends on criteria that change across the task.

The Weigl Sorting test (Laiacona et al., 2000) assesses abstraction and categorisation abilities through simple visual stimuli. The patient must group together some wooden pieces in accordance with given criteria.

The Clock Drawing test (Caffarra et al., 2011) assesses visuospatial ability and the capacity to recall and organise learnt stimuli.

The Rey's 15 words (Carlesimo et al., 1995) assesses short- and long-term memory. The patient must repeat 15 words immediately after he/she has heard them and again after 15 minutes.

The Short story (Spinnler et al., 1987) assesses short- and long-term memory by the recall of a short story.

The Forward and Backward Span test (Monaco et al., 2012) and the Forward and Backward Corsi test (Monaco et al., 2012) assess short-term memory and working memory through, respectively, numeric and visuospatial stimuli.

The recall of the Rey-Osterrieth figure (Caffarra et al., 2002) assesses visuospatial long-term memory. The patient must draw, without the model, the complex figure 15 minutes after he/she copied it.

The CAGI test (Catricalà et al., 2013) assesses denomination ability from the observation of visual stimuli.

The Line Bisection test (Schenkenberg et al., 1980) and the Bells test (Gauthier et al., 1989) assess visuospatial cognition. In the first test the patient has to split different lines into 2 equal parts. In the second test he/she has to identify the visual target stimuli among distractors. These two tests were administered only in case of suspected neglect.

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Assessment of Affective Dimensions

The Beck Depression Inventory (BDI; Beck et al., 1961) is a questionnaire composed of 21 groups of four sentences (increasing in severity of the symptom explored). Each group of statements corresponds to a specific depressive symptom. The global score (ranging from 5 to 63) is derived by the total of the answers.

The State-Trait Anxiety Inventory (STAI-X1; Zotti et al., 1989) is a questionnaire composed of 20 items describing the somatic, emotional, and behavioural sensations felt by the patient while he/she

is completing the test. For each item the patient must choose his/her answer on a 4-point Likert scale.

The Apathy Evaluation Scale (AES; Marin et al., 1991) is composed of 14 questions that evaluate the respondent's level of motivation and involvement in the activities. The patient must choose the answer on a 4-point Likert scale. The total score is the sum of the scores obtained on each item.

The McGill Quality of Life (MQOL; Sguazzin et al., 2010) is a questionnaire composed of 16 questions. Each question is based on an 11-point Likert scale. The patient provides an assessment about different areas of his/her life: quality of life in general, physical, psychological, and existential well-being. The total score is derived from the mean of the responses.

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