Master's degree in Cognitive Neuroscience and Clinical Neuropsychology

Master's degree in Behavioral and Cognitive Neuroscience

FINAL DISSERTATION

EXPLORING THE EFFICACY OF FACEBOOK-BASED TRAINING IN ENHANCING EXECUTIVE FUNCTIONS FOR ACQUIRED BRAIN INJURY PATIENTS

Supervisor:

Carmen Sáez Zea

Candidate: Andrea Maestre Cerdeño

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TABLE OF CONTENTS:

ABSTRACT

Acquired brain injury (ABI) is a prevalent disorder in the population, characterized by the presence of impairments in executive functions that can become greatly disabling, hence there is a need for highly effective treatments. The following intervention proposal aims to use tools and resources available on the Facebook platform to create a series of tasks that complement the process-based neuropsychological rehabilitation program for this type of patients. The general objective of this proposal is to design, implement and test the effectiveness of an intervention program based on cognitive training through the use of Facebook, in order to improve executive deficits present in patients with ABI. In addition, we will study the potential effects on memory functions and social skills. To achieve this, 24 patients will be recruited to participate in a 9-session treatment, and will be evenly divided into two groups, either the experimental or the control. Following the intervention, even though each group is expected to present enhancements in the assessed executive sub-processes (cognitive flexibility, attentional control, goal setting and information processing), we anticipate significant differences between them. In this way, the experimental group will show a significant improvement in executive functioning in addition to an increase in social skills and memory. This approach represents important and innovative implications for future research compared to other well-established procedures, as it offers numerous advantages, such as low cost, wide and easy accessibility, social support and motivation enhancement, flexibility in scheduling and location, diverse resources, possibility of receiving feedback, adaptability to different profiles and needs, continuity, and intervention monitoring, among others.

Keywords: acquired brain injury, executive functions, social skills, memory, Facebook-based training, social media, neuropsychological intervention.

1. INTRODUCTION

1.1. ACQUIRED BRAIN INJURY

The term acquired brain injury (**ABI**) is such a broad and heterogeneous condition that it can have diverse definitions. According to Ríos-Lago et al. (2008) and Rubio and Atarés (2019), ABI refers to an injury to brain structures that occurs suddenly and after birth. Moreover, ABI is a highly prevalent problem in Spain. According to the most recent data from the National Institute of Statistics, in 2022 there were more than 435,400 people living with this problem. Each year there are 104,701 new cases and in terms of incidence, there is a slight predominance of women compared to men (52.5%), with 65% of patients over 65 years of age (FEDACE, 2016). Of all these cases, 78% do not have a traumatic origin (such as cerebrovascular accident or stroke), the rest are due to traffic accidents, falls, blows, etc. (De Noreña et al., 2010; FEDACE, 2016). However, despite the breadth of pathologies included, degenerative disorders are not considered as such (FEDACE, 2016).

Regarding the main symptoms and consequences of ABI, physical deficits and motor disorders (such as apraxias, gait difficulties, upper limb mobility, fine motor skills and swallowing problems) stand out (De Noreña et al., 2010; Hoyas et al., 2015). These impairments are present in 90% of patients and are largely associated with the severity of disability (De Noreña et al., 2010; Martínez et al., 2021). Alterations in communication skills, as well as the inability to regulate behavior and emotions (such as apathy, lack of initiative, irritability, low control of impulsivity, low frustration tolerance, reduced awareness of limitations and poor social skills) are symptoms that affect 6% of patients, so it is also important to take them into consideration (Hoyas et al., 2015; Rubio & Atarés, 2019). Finally, according to different authors, the loss of cognitive functioning can become one of the most disabling manifestations for this type of patients, as it occurs in a generalized manner in 30% of cases (González et al., 2014; Martínez et al., 2021). As can be seen in Table 1, deficits in memory, attention (neglect), planning, reasoning, organization and time management, language (aphasia) and visuospatial are usually the most frequently observed (González, 2014; Hoyas et al., 2015; Rubio & Atarés, 2019). Ríos-Lago et al. (2008) state that this symptomatology further leads to significant functional impairment and a profound disruption in the patient's daily life (encompassing both physical and sensory aspects). Consequently, the loss of functional independence compared to the premorbid state is a prevalent characteristic among patients with ABI, observed in 89% of cases. This results in a situation of disability, placing a considerable overload of their immediate environment and impacting on the performance of activities of daily living (ADLs) (Hoyas et al., 2015; De Noreña et al., 2010).

Table 1

Main impairments after an ABI (FEDACE, 2006; González, 2014; Rute-Pérez, 2018)

Function	Features
Attention	• Inability to detect, target, maintain level of vigilance. • Reduced resistance to interference, distraction. • Reduced information processing capacity and speed (especially in patients with TBI or stroke). • Problems attending to stimuli simultaneously or successively. • Neglect. • Related to diffuse or focal lesions (frontal lobes). • Problems in sustained attention (difficulty in maintaining attention for long periods of time, with high rate of stimulus presentation, increased number of distractions) (Rute-Pérez, 2018). • Problems in visual tracking (selective attention)
Memory	• Inability to record, maintain, consolidate, recall and/or retrieve information. • Difficulties in establishing new learning and acquiring new information (free recall processes are the most severely affected). Problems in anterograde memory. • Retrograde memory problems in the period around the accident (Rute-Pérez, 2018). • Bilateral or generalized lesion: general amnesic syndrome. • Left hemisphere: intrusions and confabulation. • Right hemisphere: impaired recognition. • Temporal lobes: storage and retrieval. • Frontal lobes: use of material organization strategies, error detection and self-correction (metamemory). • Working memory, information maintenance and processing.
Executive functions	• Inability to carry out tasks of planning, control, inhibition or flexibilization of behavior. • Impaired ability to identify difficulties, change one's point of view and be able to monitor and evaluate one's own behavior or set realistic goals. • Perseverations and cognitive inflexibility. • Problems with orientation, time sequencing and movement control. • Time management problems. • Alteration of social behavior, neglect of self-care, lack of self-criticism, indifference to environment andreinforcement. • Personality disturbance. • Lack of emotional control: apathy, obsessive-compulsive disorders; pseudo-depression and pseudo-psychopathy. • In patients with prefrontal lesions, alterations in the handling of unexpected situations and in the ability to integrateand apply preserved skills to concrete situations, in addition to a lack of awareness of limitations (anosognosia) (Rute-Pérez, 2018). • Dysexecutive impairments. • Problem solving and decision making.
Visual alterations	• Haemianopsias. • Diplopia.
Perception	• Visual agnosia. • Visuospatial, visuoperceptive or visuoconstructive disturbances. • Cortical blindness. • Inability to identify, recognize and integrate sensory information (visual, auditory, tactile and somesthetic), spatial information (from self or environment) and abstract symbols (speech, writing and reading). • Visuoperceptive disturbances. • Auditory agnosia, cortical deafness, digital agnosia, related to focal affectations in parietal areas, especially on the right, and with generalized cortical affectation.
Language	• Alteration in interpreting ambiguous sentences or in maintaining the logical structure of discourse (sociallyinappropriate) (Rute-Pérez, 2018). • Alterations in word repetition, naming (anomia), pragmatic difficulties, comprehension. • Wernicke's, Broca's, nominal, transcortical and conduction aphasia. • Alexia, agraphia and acalculia.
Movement	• Inability to perform learned, sequenced and coordinated movements directed towards a goal. The deficit may depend on the planning, sequencing or movement execution. • Inability to perceive, structure and manage spatial information. • Motor, ideomotor and constructive apraxias
Emotion, personality and social behavior	• Very frequent alterations in social and moral behavior and in theory of mind (Rute-Pérez, 2018). • Major depression, generalized anxiety disorder, bipolar affective disorder and organic personality disorder (Rute-Perez, 2018). • Loss of social skills.

That being said, among all the cognitive impairments presented in Table 1, the most disabling and limiting ones for the population are those of the executive type, which include attention, working memory, and processing speed (Martínez et al., 2021). These impairments can also restrict social relationships, resulting in a high deficit in the patient's daily functionality and representing a major source of dependence, as it may, for instance, hinder reintegration into the workforce (García-Molina et al., 2015). Therefore, there is a need to effectively intervene in this type of functions by implementing an adapted therapeutic approach.

Rehabilitation is primarily a process of relearning and adaptation that enables individuals affected by the injury to recover previously developed skills, and if this is not possible, to compensate them progressively (Rubio & Atarés, 2019; FEDACE, 2006). In the rehabilitation of ABI, it must be considered that the consequences can vary depending on the location of the injury, the initial severity, extent of the affected areas and the type of underlying pathology (De Noreña et al., 2010), as well as the influence of other types of indirect variables, such as socio-cultural level, premorbid personality, age, family management and support, etc. (González, 2014). Therefore, in order to start a therapeutic intervention programme, it is essential to verify through a multidisciplinary assessment what type of sequelae and consequences the injury has caused (Rubio & Atarés, 2019), so that, within the same rehabilitation process, not only cognitive aspects are taken into account, but also emotional, physical, behavioral, visual, psychosocial, etc. (González, 2014). Furthermore, if we focus specifically on the rehabilitation of cognitive aspects, the treatment of altered neuropsychological functions should be directed towards two spheres, the neurobehavioral sphere, aimed at modifying maladaptive behaviors resulting from brain injuries or dysfunctions, and the psychosocial one (Martínez et al., 2021). There are many studies that highlight the effectiveness of cognitive rehabilitation programs in patients with ABI (Castrillón, 2019; García-Molina et al., 2015; Hernantes, 2021; Rubio & Atarés, 2014). However, it is important to consider that the interindividual variability observed in patients' response to treatment makes it difficult to establish reliable prognoses regarding recovery (García- Molina et al., 2015). There are multiple variables that may influence how the patient responds to cognitive rehabilitation, such as age at the time of injury, gender, cognitive reserve, genetic variability, type and severity of the injury or the time of onset and intensity of rehabilitation, among others (Castrillón, 2019; Hernantes, 2021). Additionally, recent research has shown that patient engagement is of crucial importance and a key factor when planning a neuropsychological rehabilitation program (Park et al., 2014).

1.2. THEORETICAL FRAMEWORK OF EXECUTIVE FUNCTIONS

In this intervention proposal, the target cognitive domain is executive functions **(EFs)**. Traditionally, they have been considered an "umbrella" term, which brings together a set of higher-order processes that govern goal-directed action and enable adaptive responses to novel or complex situations (Bausela, 2014). On the other hand, Zurcher et al. (2020) define EFs as a general term used to describe cognitive processes related to attention, concentration and control, encompassing other concepts such as working memory, attentional focus on the presence of distractors, cognitive flexibility (shifting between tasks

and tracking task performance according to demands), inhibitory control (ability to sustain attention on a task with or without distractors) and problem solving.

Different explanatory models have been proposed in the scientific literature, to account for the complexity of EFs and their interrelated dimensions, leading to a still lack of consensus to classify them in a universal way (Bausela, 2014; Anderson 2002). The theoretical paradigm proposed by Anderson (2002) known as the Executive Control System (Figure 1) suggests that EFs rely on higher and lower level cognitive functions, so they cannot be considered in isolation. According to this author, the key elements that include EFs are the development of anticipation and attention development, impulse control and self-regulation, mental flexibility and use of feedback, planning and organization, effective selection of problem-solving strategies, and monitoring (Anderson, 2002).

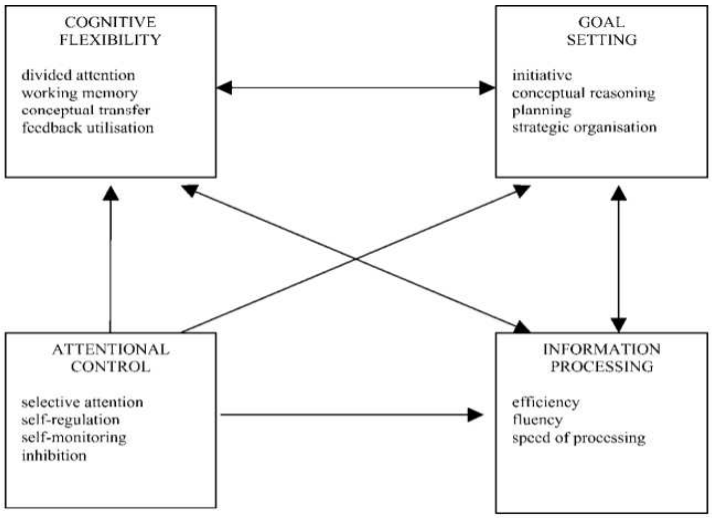
According to this model, the various EFs are classified into four interconnected domains that interact with each other and exhibit bidirectional relationships: information processing, attentional control, cognitive flexibility and goal setting (Anderson, 2002; Bausela 2014). The constituent subprocesses of each executive component are outlined in Table 2.

- *Cognitive flexibility* refers to the ability to switch between sets of responses, transition to new activities, learn from mistakes, devise alternative strategies, divide attention, process multiple sources of information simultaneously, multitask and buffer processes. Thus, inflexible individuals are often perceived as rigid, experiencing difficulties when activities or procedures are changed, fail to adapt to new demands, often encounter obstacles when they have to mentally manipulate information (e.g. mental arithmetic) or recall previously presented data. Deficiencies in this domain are also often associated with perseverative behaviors, where individuals keep making the same mistake or breaking the same rule. In severe cases, there may be a dissociation between knowledge and action, whereby an individual is able to describe the correct procedure, but then fails to perform the appropriate action.
- *Strategic organization* refers to the ability to anticipate future events, formulate and develop steps to achieve a goal, and to organize complex information or sequence the mastery of a strategy into phases in a logical and systematic way. Organization has important implications for the efficiency and effectiveness with goal attainment and is related to the ability to recall and retrieve information or plans. Deficiencies in this area result in an inability to solve problems, characterized by inadequate planning, disorganization, difficulties in developing effective tactics, reliance on previously learned strategies and poor conceptual reasoning. Therefore, good planning ability usually refers to a sequence of actions that is strategic and effective.
- *Attentional control* refers to the ability to selectively attend to specific stimuli and inhibit responses, as well as the capacity for sustained attention over a prolonged period of time. Individuals with deficits in this domain tend to be impulsive, lack self-control, fail to complete tasks, make procedural errors which they do not correct, show lapses of attention, misinterpret instructions, make mistakes in the execution of tasks, fail to achieve their goals, forget instructions and respond inappropriately.

- *Information processing* focuses on the speed, fluency and efficiency in completing new tasks or solving a problem. Patients with slow processing may have lower performance on executive tasks, but, fluency and efficiency may improve when optimal organisational strategies are used. This bidirectional relationship may partly explain why processing speed is task-specific, as the functionality of this component is related to the operability of prefrontal neural networks, being assessed in terms of speed, quantity and quality of output. Shortcomings in this area may be reflected in reduced output, delayed responses and slow reaction times.

Figure 1

Anderson's Executive Control framework (2002)



Note. Information processing is included as a separate domain since aspects of executive functioning (particularly cognitive flexibility and goal setting) cannot be assessed without considering issues of fluency, efficiency and speed of output, so the relationship between information processing and other executive domains is bidirectional (Anderson, 2002).

Table 2

Subprocesses of Anderson's model (2002)

Main component	Subprocess	Definition
Cognitive flexibility	Divided attention	Ability to attend to different stimuli or tasks at the same time and respond to the multiple demands of the environment.
	Working memory	The process by which information is temporarily stored and manipulated.
	Conceptual transfer	Ability to transfer or use other knowledge to develop alternative strategies.
	Feedback utilization	Ability to learn from mistakes based on external instructions.
Attentional control	Selective attention	Ability to attend selectively to specific stimuli, processing relevant stimuli and suppressing irrelevant stimuli that may appear simultaneously with relevant stimuli.
	Self-regulation	Use of self-directed adjustments, modifications and actions (in cognition, behavior and emotions) to identify and choose actions that can achieve certain goals.
	Self-monitoring	Regulation and monitoring of actions, so that plans are implemented in the correct order, errors are identified and goals are achieved.
	Inhibition	Ability to deliberately suppress thoughts, behaviors and/or emotions in order to act in a specific way.
Goal setting	Initiative	Ability to start an activity and devise a plan to complete the activity.
	Conceptual reasoning	Ability to identify patterns or relationships that are not obvious or to identify key points in complex situations.
	Planning	Anticipate future events, formulate an objective and devise a sequence of steps or actions to achieve the objective.
	Strategic organization	Ability to organise complex information or a sequence of steps in a logical, systematic and strategic way (related to planning)
Information processing	Efficiency and fluency	Ability to process information and provide answers efficiently in the shortest possible time.
	Speed of processing	Speed at which information is catched, understood and begun to be responded to, affecting executive functioning.

Based on the premise by Anderson's (2002) explanatory model, this intervention proposal has been designed.

1.3. SOCIAL NETWORKS AND THEIR COGNITIVE AND SOCIAL EFFECTS

Nowadays, the majority of the population uses social networks (**SNs**) in a superficial way. They tend to relate them to leisure and entertainment, often not using the advanced tools they offer. According to different authors, platforms such as Facebook and Twitter encompass functions that involve significant cognitive processes, so that neuropsychological training based on social media can become a useful tool as a treatment to stimulate multiple domains and improve social interaction (Kieling et al., 2017; Quinn, 2018).

Previous literature supports this idea, and indeed, recent research has highlighted that the use of SNs improves overall cognitive performance (Rute-Pérez, 2018). Supporting this, the social activity itself and the engagement demanded by these platforms has been linked to greater efficiency in functional networks, and consequently, greater cognitive reserve (Myhre et al., 2017; Sörman et al., 2017; Yildirim & Obel-Balaban, 2021).

Other studies have found that such social interactions through the internet can enhance specific cognitive aspects such as EFs (Khoo & Yang, 2020; Kieling et al., 2017). This can be explained by the fact that when using SNs, various processes are required to direct attention to multiple stimuli, make judgments or execute motor movements, which rely on the activation of several brain systems, including the visual network, the frontoparietal attention network, the central executive network and the motor network (Yildirim & Obel-Balaban, 2021). In particular, an effect on cognitive flexibility has been demonstrated, as seen in the study conducted by Myhre et al. (2017), where a higher performance in working memory (information updating) and divided attention was observed in the group that socially interacted through Facebook after the intervention. These results are similar to those found by Lara and Bokoch (2021), who observed that participants who interacted on SNs by sharing content (comments or "likes") showed an increase in working memory. This improvement was associated with the fact that many activities on SNs, such as reading and viewing images and videos, require the ability to retain and update information over short periods of time in order to react and respond appropriately (Meshi et al., 2016; Lara & Bokoch, 2021).

There is other research that have shown that the use of SNs as an intervention tool enhances attentional control, since in order to use them effectively, processes of greater inhibitory control have to be invoked and demanded due to the large amount of information presented to users (e.g., news, advertisements, connection recommendations, chat boxes, spam...) (Quinn, 2018). They must prioritize the type of information that is essential to achieve immediate purposes, filtering attention to relevant information flows (e.g., news is important to obtain information about connections, chats are relevant for synchronous conversation, etc.), while discarding those that are irrelevant (Meshi et al., 2016). Similarly, Lara and Bokoch (2021) state that the very nature of SNs is to bombard the user with a multitude of information, thereby SNs competition for the user's attention can test their

inhibitory capacity, interference control and selective attention. In the same way, Quinn (2018) has also demostrated this increase in EFs associated with SNs interactions (reading or watching content while generating it), as it requires the ability to filter and suppress irrelevant information in order to maintain and update relevant information, and thus enabling appropriate responses.

Several studies have confirmed the relationship between SNs and information processing. An improvement in processing speed has been observed in tasks that stimulate visual scanning and tracking among participants who engaged in interactive communication, thus carrying out considerable information management (Milovich & Burleson, 2020; Myhre et al., 2017; Yildirim & Obel-Balaban, 2021). Finally, goal setting has also been found to be related to the use of these platforms, albeit in a more indirect or non-significant way, as participation in SNs requires cognitive processes such as directing attention to multiple stimuli, then making judgments and executing an action plan directed towards the stimulus or goal to be achieved (Meshi et al., 2016; Reed, 2023). Therefore, these platforms trigger and stimulate, albeit more secondarily, executive sub-processes such as initiative or planning (Miropolsky et al., 2020; Lara & Bokoch, 2021).

In addition to EFs, it has been found that other cognitive domains affected in patients with ABI can also benefit from the use and training based on SNs (Quinn, 2018). In research conducted by Yildirim and Obel-Balaban (2021), it was found that stimulating EFs through the various resources available on these platforms promotes information retrieval and encoding, as well as the generation of new cognitive strategies. This was associated with a secondary improvement in episodic memory and face identification among participants who received SNs training, because the ability to remember information (e.g., birthday reminders or remembering passwords) and to retrieve semantic and episodic associations related to faces is required in order to interact with online content and interpret social interactions appropriately (Sörman et al., 2017; Quinn, 2018; Yildirim & Obel-Balaban (2021). Similarly, memories associated with emotionally significant events tend to be selectively retained, thereby stimulating memory, specifically verbal (both immediate, long-term and short-term recall), episodic and semantic memory (Kieling et al., 2017).

Considering everything discussed so far, it is to be expected that patients who have suffered an ABI can benefit from these tools if they are included in a neuropsychological rehabilitation process. However, it is crucial to consider a series of "barriers" when implementing this type of intervention (Tsaousides et al., 2011). The first limitations that patients face are the cognitive ones, so it is essential to first identify the specific difficulties that may interfere with their ability to use SNs effectively, in order to provide tailored training and compensatory strategies to facilitate their use (Brunner et al., 2022). For example, training can focus on enhancing skills for retrieving or remembering passwords or even recovering the steps needed to access the computer or email, as these difficulties may be associated with problems of memory, attention or disorganisation (Tsaousides et al., 2011). Patients may also experience comprehension issues (e.g. understanding instructions for using the Internet or the content of websites), visual organisation difficulties (e.g. not being able to find the correct answers to questions) and slow processing speed (e.g. taking a long

time to find things), which need to be identified when planning the intervention approach (Brunner et al., 2015).

Another barrier to consider is social isolation and loneliness. In a study conducted by Brunner and colleagues (2022), these were found to be a common challenge for individuals who have suffered an ABI, and therefore, SNs are tools that can provide a positive and low-cost means for these patients to connect with others in similar situations, sharing opinions and experiences through chat rooms, message boards, or distribution lists, and even Facebook groups. Thus, despite the widespread negative connotations of these technological resources, they can be a useful resource for increasing patients' perceived social support and reducing their social isolation. Previous studies have also shown a direct relationship between the use of these SNs and an increase in social skills, including that, an improvement in verbal and communication skills, as well as more effective strategies for interactions with peers have been observed (Myhre et al., 2017; Brunner et al., 2022).

These benefits are achieved because these platforms have a variety of advantages, such as being free, easily accessible, comprehensive, widely available con a global scale, with very accessible instrumentation and with easy adaptability of content to the specific needs and demands of the patient. Additionally, SNs allows for long-term continuity and follow-up of the intervention, making it more reachable as patients can access the content at any time and return to it as needed. Therefore, what is proposed is an intervention program for patients with ABI through these platforms' resources.

1.3.1. Facebook and its tools

As an instructional task for this intervention proposal, the Facebook platform was chosen, an online social media and networking service that was created in 2004 in the United States (Ehlhardt et al., 2005). Today it is one of the most popular in the world and dominant among adults, with 2.8 billion monthly active users, 1.84 billions of whom log on daily basis (Ahmadi et al., 2022). Facebook provides a mechanism for users to build and maintain a wide range of social connections (from family, friends, colleagues and co-workers to strangers around the world), as well as allowing users to share messages and images with their friends and to get involved in local events, pages they support or groups (Ahmadi et al., 2022; Ehlhardt et al., 2005).

According to Ehlhardt and colleagues (2005), the advantages that this platform brings to the proposal of a neuropsychological intervention are that it is a complex tool and requires the completion of a number of steps. Moreover, it is an ecologically valid resource, widely used by the non-affected population (normative population), as it is highly embedded in our daily lives. On the other hand, it has the potential to reduce the social isolation suffered by people with ABI, indirectly improving social relations, as well as being cognitively stimulating due to its large amount of resources. Therefore, Facebook offers a series of tools and utilities that enable the achievement of the objectives and hypotheses of this intervention, as they would be linked to the use of certain cognitive functions by the user. Among them, the main and most characteristic ones can be seen in Table 3.

Table 3

Key Facebook tools and resources

Tools	Description
Registration/ log in	In order to access their personal profile, users are asked to enter their email address or user name and associate it with a password of their choice (which they must remember).
Personalization	When you create a personal page on Facebook, you can customize it according to your preferences by adding a profile picture, which allows others to identify you better. The characteristic of a personal profile is that it allows the user to interact with their friends, post images, texts, videos, etc.
Home	What you see when you log in to Facebook, and includes your "feed" or wall, the constantly updated list of friends' posts, the groups you belong to, the pages you follow and more.
Tagging and mentioning	When a friend tags a user in a post (that user appears in the content), that user can share that content on their profile (and their profile name is visible), but when a user is mentioned, the @ symbol brings up the user's name and gives direct access to the profile without being identified.
Add friends	It allows you to add and connect with friends and acquaintances from all over the world, linking different people. On Facebook, you can add other people as friends and see the content they share on their profiles. It has a suggestion section in which it shows possible people that the user may know and may want to add as a friend.
Chat	It is the practical and quick way to communicate not only with friends, but also with other people who are registered on the network. It is possible to send messages in real time, as well as share images, videos, links, audios, files, and send gifs, pictures and the user's current location.
Sharing content	You can share information about yourself (such as location, work, school and relationships) on each personal profile and/or on pages and groups you belong to. This can be done through photos, texts and videos about activities and thoughts. By sharing content, you can share information, updates, opinions and news with other users, while also being able to see other people's posts on your "wall" (the main page of your profile). Also, content can be shared through stories (publications that remain on the profile for 24 hours), or reels (videos in which elements such as music, text, etc. can be inserted).
Following a page or group	When you "Like" a page, you can follow the news that is posted on it, allowing the public to interact directly through comments, "likes" and messages. Facebook has pages and groups dedicated to specific topics, where you can follow brands and organisations or join communities of people with similar interests. In addition to that, the personal account shows the pages followed, indicating what the user's preferences are.
Events	Tool to communicate to contacts the celebration of a party, birthday, celebration, course or any other event.
News and suggestions	This section shows posts from friends and pages you follow, and the "Suggestions" section shows content that might be of interest based on your activity on the SNs.
Advertisements and spam	Facebook is used by companies and organizations to promote their products and services through advertisements and marketing on the SNs.
Notifications	Facebook activity updates that you receive whenever a friend or page posts or shares something with you. These can be configured to determine which notifications you want to receive and in what way.
Memories	Section in which you can see the publications that have been uploaded, as well as publications in which the user has been tagged and anniversaries, among other content.
Save content	You can save links or videos posted by friends, events, pages or photos, which are of interest and can be viewed later.
Activity record and history	Tool that allows you to review and manage your Facebook activity (you can scroll through content or filter by category to review specific things, such as posts, posts you've been tagged in, photos and videos, friend requests and events).
Games	The platform has a section of games in different categories.

1.4. OBJECTIVES AND HYPOTHESES OF THE INTERVENTION

The general objective of this proposal is to design, implement and test the effectiveness of an intervention program based on cognitive training through the use of Facebook, with the ultimate aim of improving the executive deficit present in patients with ABI. In addition, we will study the potential effects on memory functions and social skills.

As ***specific objectives,*** the following are considered:

- To test the efficacy of Facebook-based treatment for the improvement of EFs in patients with ABI.
- To investigate the possible indirect improvement in other cognitive functions following the implementation of this intervention programme, such as memory in patients with ABI.
- To determine the possible effect of the Facebook-based intervention on social skills in terms of appropriate behaviors that occur in interpersonal contexts, reflecting the person's feelings, attitudes, rights and opinions.

Main hypothesis: the neuropsychological intervention programme that includes the Facebook-based treatment will be effective in enhancing the executive performance of patients with ABI, as well as in indirectly improving memory and social skills.

The ***specific hypotheses*** pertaining to these objectives are as follows:

- The combination of neuropsychological treatment and Facebook-based intervention will effectively improve deficits in executive functioning in patients:
    - Post-intervention, there will be a significant increase in scores on standardized neuropsychological tests measuring executive functioning, specifically in the intervention group. In contrast, no significant differences will be observed in the control group when comparing pre- and post-intervention scores.
    - The greatest improvement is expected in executive components related to cognitive flexibility, attentional control, and information processing, while other sub-processes of executive functioning, such as planning, reasoning, and strategic organization, may show less significant improvements.
- Indirect enhancement of patients' memory functions is anticipated due to the fact that these platforms stimulate the retrieval of information and the generation of strategies to achieve goals. Indirect enhancement of patients' memory functions is anticipated due to the fact that these platforms stimulate the retrieval of information and the generation of strategies to achieve goals.
- The interactive environment provided by the tools available on Facebook is expected to lead to indirect improvements in social skills, encompassing verbal and non-verbal (emotional) communication skills, pro-social behavior, and the interpretation of social situations among peers.

2. MATERIALS AND METHODS

2.1. STUDY DESIGN

The described research proposal will follow a mixed design. As dependent variables (DV), the scores obtained by the patients from each group on the neuropsychological test measures that assess the executive processes described by Anderson (2002) will be taken, along with scores on the social skills and memory tests (see Assessment measures). On the other hand, the type of treatment applied and the time of neuropsychological assessment (pre- and post-treatment) will be taken as independent variables (IV). This research proposal will be a randomized controlled trial, meaning that patients will be assigned to one of the two proposed groups, the control group (CG) and the experimental group (EG).

A pre-post repeated measures experimental design within each group will be carried out, with the aim of finding out whether the possible effect observed between pre-intervention and post- intervention depends on the group to which the participants have been assigned. Furthermore, it is proposed to implement a single-blind study, so that one researcher will solely be in charge of performing the pre and post evaluations, without knowing to which experimental group the participants belong or what the hypotheses set out in the study are.

2.2. PARTICIPANTS

The target population for this intervention proposal consists of adults who have experienced some type of ABI (either stroke, TBI due to traffic accidents, etc.). This selection will be made according to the patient's neuropsychological profile. The total number of our sample will be 24 (N=24), who will be recruited from the Sinergia center of the AISSE foundation (see *Procedure).* This sample size is based on the number of new users that typically come to the center per month and, therefore, we estimate that it could be feasible to carry out the intervention and obtain statistically significant results. Furthermore, similar studies with this sample size have found substantial effects in their research (Brunner et al., 2022; Milovich & Burleson, 2020; Myhre et al., 2017). Lastly, all patients in the research will be adequately informed about data treatment and protection in accordance to current legislation (see Annex 1).

The inclusion criterion for our study are as follows:

1. Patients with a diagnosis of ABI. Although we currently lack standardized diagnostic criteria and a classification for this entity, patients will undergo examination by a medical professional and must meet at least one of the conditions proposed by PIDEX-2 (Castellanos-Pinedo et al., 2012).
2. Aged between 18 and 65 years. The age range of the sample has been limited to the adult population in order to reduce the variability of the results and to ensure a more homogeneous group. Besides, upper age limit is set at 65 years because age is a known risk factor for cognitive impairment (Khoo & Yang, 2020; Quinn, 2018; Myhre et al., 2017).

3. Scoring below the cut-off point on the INECO frontal screening scale (IFS) based on the patient's educational level (Zapata-Zabala et al., 2019). This test allows identifying and measuring cognitive dysfunction in patients with complaints regarding their cognitive performance and their functional abilities in tasks requiring executive functioning. It incorporates different tests to assess their frontal function.
4. Newly admitted patients, who have not undergone any previous neuropsychological rehabilitation process.
5. Presence of cognitive complaints in EFs (cognitive flexibility, attentional control, goal setting and information processing).
6. Prior contact with Facebook or another platform to ensure the patient's motivation, interest and commitment to the intervention. The patient's commitment and motivation to the intervention process makes them willing to explore and take on new roles (adopting new coping strategies, developing specific skills or setting new goals) to improve their functioning and achieve therapeutic goals (Yildirim & Obel- Balaban, 2021).

On the other hand, all those persons who (1) do not meet all the inclusion criteria, (2) receive another type of neuropsychological treatment, (3) have any clinical condition that impede the application of the intervention protocol, (4) receive some type of pharmacological treatment that affects cognitive performance, or (5) show comorbidity with other neurological diseases, will be excluded.

2.3. ASSESSMENT TOOLS

The following is the standardised neuropsychological testing protocol presented for pre- and post- treatment measures (Table 4).

Table 4

Standardized neuropsychological tests applied both pre- and post-treatment measures

Domain	Executive component	Test	Executive sub-process
EFs	Cognitive flexibility	WAIS-IV digit subscale (direct, inverse and increasing) (Weschler, 2012).	Working memory (auditory-verbal)
		WAIS-IV Letters and Numbers Subscale (Weschler, 2012).	Working memory (auditory-verbal)
		Five Digit Test, FDT (Sedó, 2007)	Divided and alternating attention.
		Trail Making Test (TMT), part B (Reitan, 1956)	Divided attention.
		Paced Auditory Serial Addition Test, PASAT (Gronwall, 1977)	Working memory and divided attention.
		Verbal fluency test	Working memory, verbal generation and recall and alternation.
	Attentional control	D2 test (Brickenkamp, R. & Zillmer, E.,1998)	Selective attention and inhibitory control
		Five Digit Test, FDT (Sedó, 2007)	Inhibitory control, monitoring and selective attention.
		Trail Making Test (TMT), part A (Reitan, 1956)	Selective attention.
		Paced Auditory Serial Addition Test, PASAT (Gronwall, 1977)	Selective (and sustained) attention and inhibitory control.
		Verbal fluency test.	Inhibitory control.
		WAIS-IV Symbol and Digit Test (Wechsler, 2012)	Selective (and sustained) attention.
	Goal setting	Rey-Osterrieth Complex Figure, ROCF (Rey, 1964)	Strategic and perceptual organization and planning.
		Zoo Map Subtest of the BADS Battery (Wilson et al., 1996)	Planning, sequencing, reasoning, problem solving, organisational skills and initiative.
		Tower of London, ToL (Injoque-Ricle & Burin, 2008; Shallice, 1982)	Planning and problem solving, strategic organization and reasoning.
	Information processing	Five Digit Test, FDT (Sedó, 2007)	Speed and efficiency of processing.
		Paced Auditory Serial Addition Test, PASAT (Gronwall, 1977)	Speed of processing.
		Verbal fluency test.	Fluency and speed of processing.
		Trail Making Test (TMT), part A (Reitan, 1956)	Speed of processing.
		WAIS-IV Symbol and Digit Test (Wechsler, 2012)	Speed of processing.
		ROCF (Rey, 1964)	Processing speed (copy time) and information processing style.
Social skills		Social Skills Scale (TEA, 1998)	Specific social skills, verbal and non-verbal communication skills, assertiveness and problem solving.
Memory		Verbal Learning Test (Spain-Complutense), TAVEC	Verbal memory and learning.
		ROCF (Rey, 1964)	Immediate visual memory

2.4. PROCEDURE

Pre-intervention (sessions 1-3)

The assessment and subsequent intervention will take place at the Sinergia Center, where the AISSE Foundation's healthcare activity is carried out, dedicated to the treatment of neurological pathology through neurophysiotherapy, occupational neurotherapy, neurospeech therapy and neuropsychology for adults and children (for more information, please consult the centre's website https://www.aisse.es/).

During the first session, the initial assessment interview with the patient will be conducted to determine what their complaints or symptoms are and to complete the anamnesis. In addition, the INECO IFS will be administered to evaluate the existence of executive impairment, given that one of the requirements for inclusion in the sample is to obtain a score below the established cut-off point. If the patient does indeed meet the established inclusion criteria, they will be invited to take part in the study. They will be informed that if they accept, two additional weekly sessions of two additional 45-minute rehabilitation sessions per week will be added to the foundation's proposed sessions for a duration of 5 weeks. Finally, if they agree to participate, the nature of the research will be explained to them, and they will sign an informed consent form (Annex 1) to proceed with intervention proposal.

Throughout the remainder of session 1, and over the course of sessions 2 and 3, the baseline (or pre-treatment) neuropsychological assessment process (see *Instruments)* will be carried out in the same room as the initial assessment interview, which provides optimal conditions and is free of distractors.

The entire process of initial assessment and evaluation (three sessions of 45 minutes each, over two weeks) will be conducted by a group of researchers (expert neuropsychologists): the first will perform the initial assessment and patient selection (R1) while the second will carry out the blinded pre and post neuropsychological measurements (R2).

Intervention (sessions 4-12)

Once the patients to be included in the study sample have been assessed and selected, they will be randomly assigned to one of the two groups, so that 12 patients will belong to the target group of the proposed intervention (GE), and the rest will be allocated to the CG (this process will be carried out by R2). The procedure followed for each group is described in detail below:

a. Neuropsychological treatment programme:

Nine 45-minute sessions of individualized neurocognitive training will be conducted, with a frequency of two sessions per week (spanning a total duration of 5 weeks). The rehabilitation will be carried out on an individual basis by a professional with previous experience in the field of neuropsychology (in this case, it will be researcher 3, R3) at the same center described in the *Pre-intervention* phase, albeit in a different room than the one

used for the initial assessment and evaluation interview. The room will provide the same optimal conditions required for bringing about a neuropsychological treatment process, including good lighting, temperature control, a blackboard and other materials that may be useful for these sessions. We then proceed to design and implement a series of individualized rehabilitation sessions aimed at addressing those cognitive deficits that have an impact on daily activities and that are significant for each individual, based on the previous assessment. The focus will be on enhancing the strategies that are available, and directing the rehabilitation towards the target function of the intervention (in this case the EFs) while considering the person's environment. One approach to achieve this is to work with the patient through various tasks, games and activities based on cognitive processes, so as to stimulate the executive subcomponents targeted by the intervention, such as divided and selective attention, visual discrimination and/or inhibitory control, working memory, planning and problem solving, processing speed, initiative, self-monitoring... (Castrillón, 2019; Salazar-Flores et al., 2022). Castrillón (2019) proposes some guidelines to follow in neurocognitive training:

- Perform exercises of short duration, providing immediate feedback on performance and gradually increasing the duration and load of the tasks according to the patient's response.
- Plan therapy considering the individual characteristics of the patient, vary activities frequently and ensure they are dynamic and engaging to avoid demotivation.
- Simplify instructions and reduce the amount of information, providing verbal or visual aids as necessary.

b. Neuropsychological treatment programme accompanied by EFs intervention through Facebook (EG):

In addition to following the same treatment described in the CG, two extra sessions per week, each lasting 45 minutes (a total of 9 sessions over 5 weeks), will be added to the EG. This number of sessions has been determined to carry out the treatment proposal based on previous studies with similar objectives that implemented the same conditions and achieved significant results after upon completion of the intervention (Brunner et al., 2022; Milovich & Burleson, 2020; Quinn, 2018). These Facebook intervention sessions will be conducted by the R3 and will take place individually in the same room where the center's neuropsychological treatment programme takes place. For these sessions, the patient can use their own computer, or the one available at the foundation.

It was decided to divide the intervention sessions into two phases. In both phases, it has been proposed that the sessions will be based on the TEACH-M intervention by Ehlhardt and colleagues. (2005), an instructional package that facilitates learning and retention of multi-step procedures (as in this case, learning of Facebook, as well as the completion of the proposed tasks) for people with executive deficits as a result of brain injury. This intervention is composed of 7 steps (summarised in Table 5) aimed to learn the new skill that the conducting researcher should be familiar with and implement during the intervention.

Table 5

Summary of the TEACH-M program characteristics (Ehlhardt et al., 2005)

Feature	Rationale
Task analysis (knowing the content of the instruction, breaking it down into small steps, and chaining them together)	• It facilitates step-by-step instruction. • Forward chaining facilitates learning the initial step; applied to the E-Steps programme, it parallels the use of regular mail (i.e. go to the mailbox, open it, read the letter and reply), it can be likened to Facebook. • Focusing on a single task in depth facilitates mastery of acquired skills.
Errorless learning (minimize errors during the acquisition phase, model the steps before the patient attempts a new skill or step, carefully fade out support, if an error occurs, demonstrate the correct skill/step and ask the patient to repeat it).	• Optimal for patients with severe problems of anterograde memory, and who have difficulties with trial-and-error approaches. • Modelling and careful fading of support facilitates errorless learning. • By having multiple opportunities for practice (trial and error), learning is consolidated.
Performance assessment	Initial assessment of skills prior to treatment and evaluate the performance of the current test at the beginning of the teaching session and/or introducing a new step.
Cumulative review	Periodically review previously learned skills.
High rates of successful practice tests	Consists on practicing the skill several times. Spaced retrieval intervals improve the consolidation of information.
Training in metacognitive strategies (prediction technique and self- reflection can be used to encourage active processing of the material).	• Prediction-reflection with screenshots (metacognitive strategy) increases awareness of performance and task demands; task lists (checklists) help to decrease memory load. • Self-reflection in the form of metacognitive strategy training is another direct instruction technique that has been studied in the Dysexecutive Syndrome population.
Metacognitive strategies	• Retraining or compensating for impaired EFs through the deliberate use of strategies that enhance self-regulation of cognition. • The most effective are self-instructional sequences (e.g. goal management training), verbal self-regulation and the prediction technique in which a client predicts the outcome of his or her performance.
Summary of what has been learned	Helps to consolidate information

1. Approximation and familiarization with the resources available on Facebook:

Although patients should be familiar with the platform, and in fact may even have an pre-existing account prior to the intervention, the aim is to review and reinforce the essential aspects of the tool, given that, on many occasions, after an ABI, patients may have forgotten most of the functionality of the Facebook resources, so they would have to learn from scratch. The learning and approach to the platform will be brought about using a Facebook account specifically created for the intervention programme or, failing that, the account of one of the researchers who give their authorization can be used.

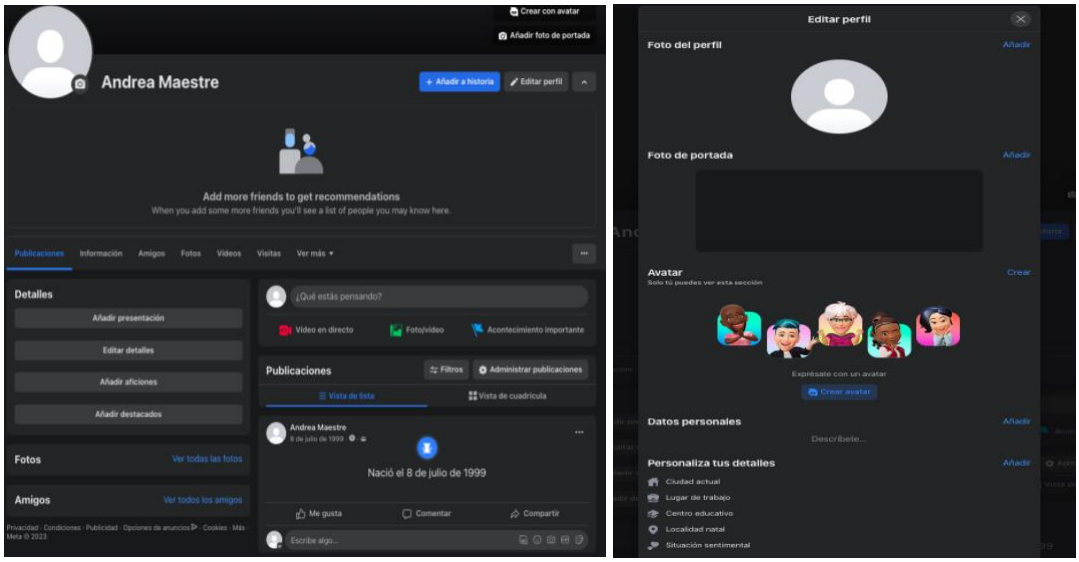
This phase will consist of a total of 3 sessions, each lasting 45 minutes, distributed over 2 weeks and conducted by R3. The contents addressed in each session of the first phase includes:

- In **Session 4**, the process of editing the personal profile as well as the description of each symbol appearing on the home screen and the actions that can be performed through them will be specified (Figure 2).

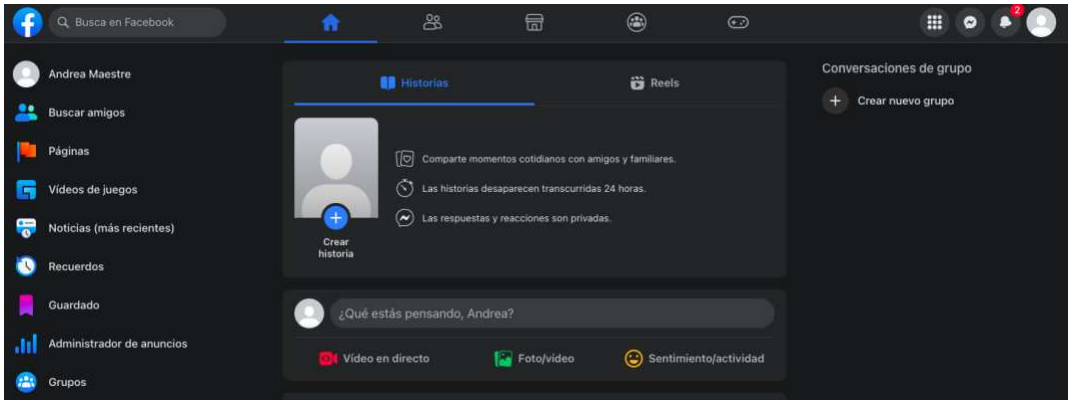
Figure 2

Contents discussed in Session 4

a.



b.



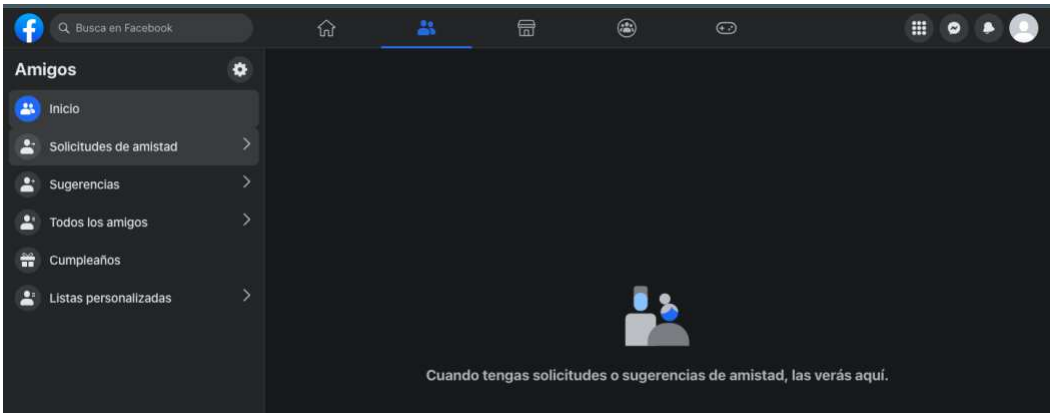
Note. The figure shows (a) the personal Facebook account page where the user can edit the information according to their own data and (b) the homepage of the platform with all its functions.

- **Session 5** will detail the steps needed to search for friends on Facebook and the procedure for sending and/or accepting friend requests. Additionally, in this session, patients will learn how to send private messages via chat feature to added friends (different from the public messages or comments that will be explained in the next session) (Figure 3).

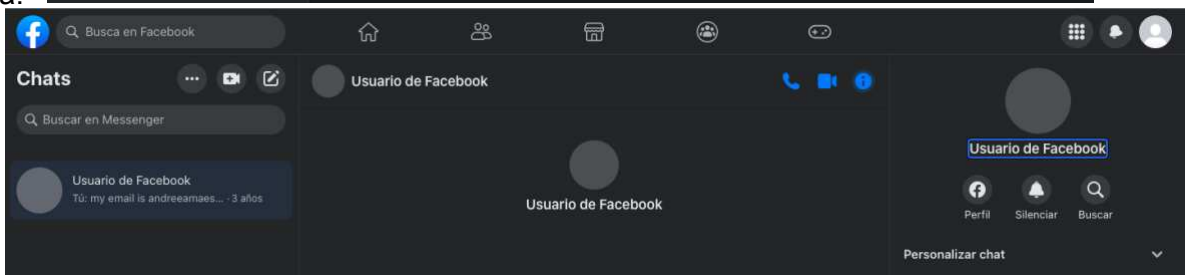
Figure 3

Content discussed in Session 5

a.



b.



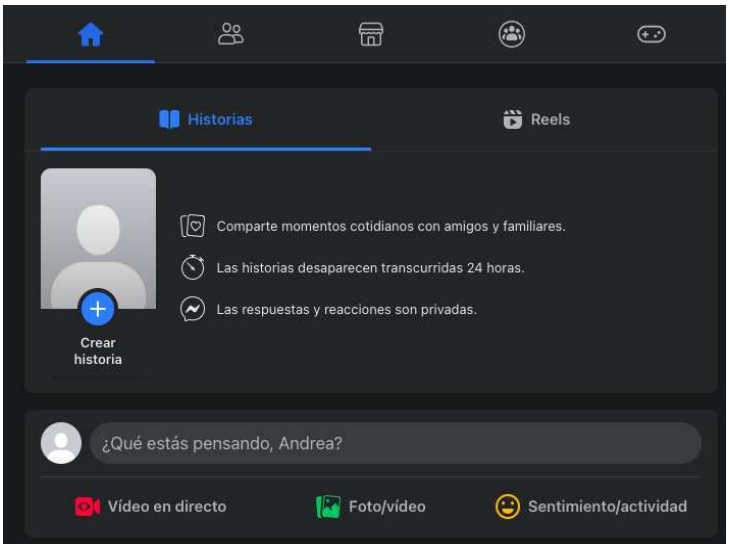
Note. The figure shows (a) the friend requests page and (b) the chat page of the platform.

- In **Session 6,** the usefulness of the platform for interacting with other people, showing how to upload content (such as photos and videos in formats like reels or stories) or leave comments on different profiles, as well as how to share information about news and photos or videos of interest with friends, will be taught (Figure 4). Once patients learn how to share information, they will be guided on how to express their opinion on what other people share through comments, reacting with "likes" and sharing friends' posts. During this session they will practise with pre-existing material stored on the computer or, alternatively, with material obtained from the Internet browser.

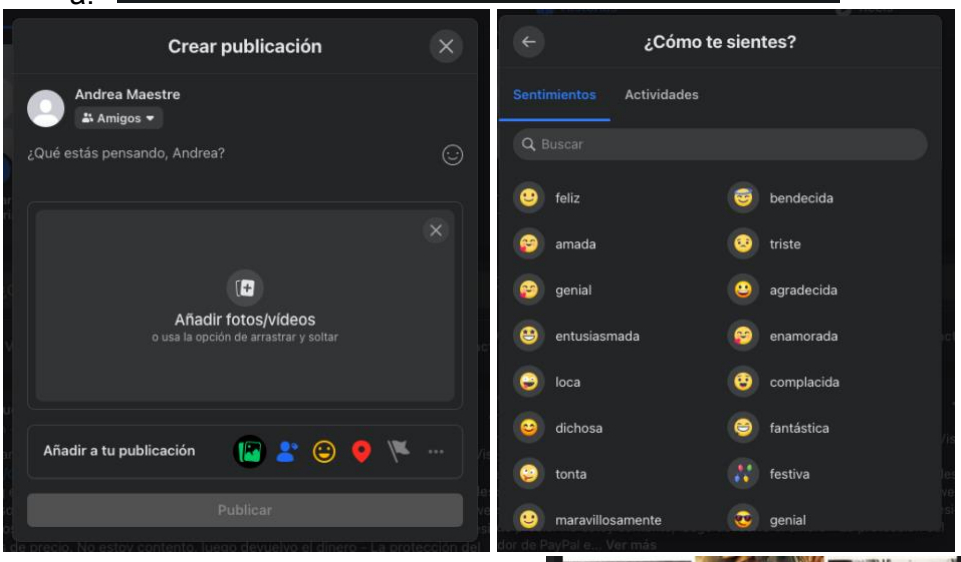
Figure 4

Content discussed in Session 6

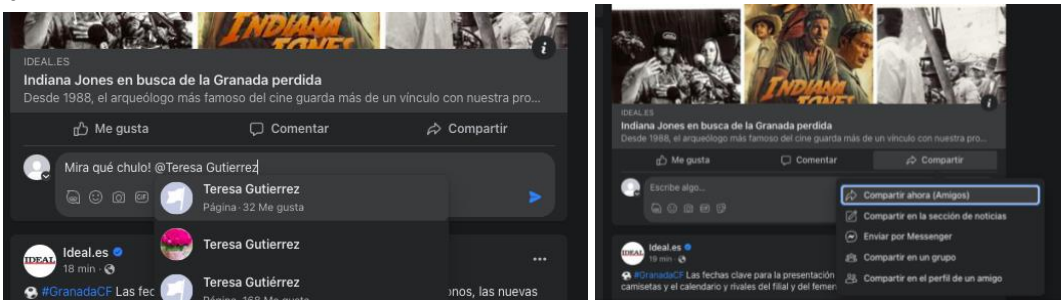
a.



b.



c.



Note. The figure shows (a) the upload content function in Facebook homepage, (b) the specific steps available in the platform when sharing content, and (c) the process of sharing posts or comments with friends' pages.

2. Implementation of specific tasks in order to train EFs based on Facebook utilities:

In this part of the intervention, proactive engagement in specific tasks based on the tools and resources available on the Facebook platform in order to train patient's EFs is proposed. These tasks will be categorized according to the sub-processes outlined in the Anderson Executive Control System paradigm (2002), assigning a specific Facebook tool and resource to each of them.

The phase comprises 6 sessions of 45 minutes each, distributed over 3 weeks, and conducted by the R3. At the beginning of each session, the patient will be required to write a comment in the "What are you thinking?" section on the home page, serving as a record of their weekly activities. Additionally, they will be encouraged to check their notifications to promote interaction with their added friends. The content of each of the sessions is specified below:

Table 6

Tasks for each session addressing different cognitive components of the neuropsychological intervention

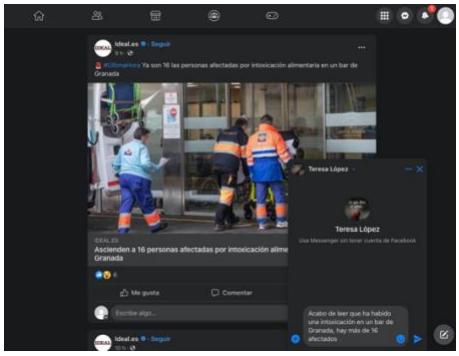
SESSION 7 **Cognitive flexibility**	
Target	This task aims to intervene on the executive sub-process of working memory.
Task	In this session, the patient will be asked to register on the platform. To do so, they will have to use their email address, choose a password that they will have to remember every time they want to access the account, and personalize their profile by describing things about themselves (date of birth and place, hobbies, brief description of who they are, uploading a profile picture...). At the end of the session, the patient will search for family members or close friends to add, and will follow pages or groups of interest to complete their profile.
Rationale	This activity not only helps with working memory training (having to make a timeline of personal events to complete the profile), but also stimulates autobiographical memory, orientation in time, place and person, and attention, among others. Once the patient has created a Facebook account, he or she must log in. In this action, the patient is presented with a large amount of information that they must assimilate, process and manipulate to determine if it is relevant, and execute actions according to this assessment of their interests and needs. This behavior may consist of ignoring the information and continuing to consult the page in search of other interests, or processing it for future use. According to Alloway et al. (2013), this resembles the cognitive processes involved in performing a standardized working memory task. The latter activity of adding friends, following pages and completing the profile will train not only working memory, but also the executive sub-processes of selective attention and initiative.
Example: a.  b. 	

Note. The example shows (a) the Log in page with the required email and password and (b) the registration function of the platform with all the data necessary to provide in order to create a new account.

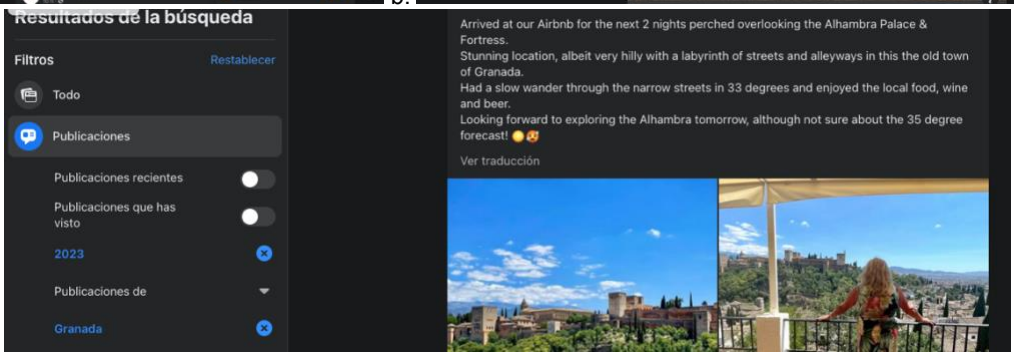
SESSION 8
Cognitive flexibility

Target	This task seeks to intervene on the executive sub-processes of divided and alternating attention, as well as conceptual transfer.
Task	Three tasks are proposed for this session: 1. The patient, while reading a news item, group or page of interest, will open the chat and share what they are reading with a friend. 2. The patient will look at photos uploaded by a person or a group. Each time the researcher mentions a specific word, such as "red", the patient will have to identify and mention something red in the photo. 3. To end the session, the patient will be asked how he/she would search for, for example, content that has been uploaded or is exclusively in the city of Granada this year.
Rationale	With the first task, the patient is required to alternate between reading, assimilating and understanding the content, and communicating with another person, which stimulates fluency in both information processing and language use. On the other hand, with the second task, divided attention is trained as they have to divide the attention and attention between an action that is highly automated and another that also requires high attentional resources. Finally, the third activity aims for the patient to apply their prior knowledge that the search engine is used to find friends or groups, and to make an inference that the search engine can also be useful for finding places, content or events.

Example

a. 

b. 

c. 

Note. The example shows the tasks of (a) while reading a content (new or group), open the chat and tell to a friend what the patient is reading, (b) looking at photos uploaded by a person or group and in this case, if the word “red” is said, the patient will have to say or point to the red awning in the background, and (c) searching content that has been upload in the city of Granada this year.

	SESSION 9 **Goal setting**
Target	This task aims to intervene on the four sub-processes of this executive component in the same session: initiative, planning, conceptual reasoning and strategic organization.
Task	To encourage initiative, at the beginning of the session the patient will be asked what they would like to upload in their first publication (e.g. a cooking recipe). Then, write down on a piece of paper all the steps needed to complete the task. For example, you can start by finding a video explaining how the recipe is made and save it for easy access. Then, write down the ingredients and the steps of the recipe. Then, they record the recipe on video. Once recorded, click on the photo/video option and determine for which audience the video will be uploaded, either for the whole audience or just for friends. Then write a caption describing the recipe and, finally, once the post is uploaded, it will be shared by different groups. Once all the steps have been written down, it will be explained to the patient that their objective during the session will be to complete the task but they have limited time, and given that the time allocated is short and it is not possible to complete all the steps written down in that time, they will have to complete at least a part of each of them.
Rationale	What is sought and what is important about this activity is that it is not about completing the task, but about doing at least a part of each of the steps to accomplish it. By allowing the patient to advance and carry out the task at his own pace, the emphasis is placed on reasoning and planning so that he himself will have to fragment the achievement of the steps in order to reach the proposed objective. Therefore, in addition to the above-mentioned sub-processes, interventions are also made on sequencing, decision making, working memory, problem solving and monitoring.
	SESSION 10 **Attentional control**
Target	This session focuses on the training of the executive sub-processes of selective attention.
Task	At the beginning of the session, the patient will be informed that during that day's session, he/she will have the opportunity to enjoy one of the games on Facebook. However, the researcher will not tell the patient which game it is, but rather the patient will have to discover where the game is and how to get to it based on a single clue (a picture of the game or the word "differences" in the game's title can be presented). Therefore, the patient would be asked how from the clue he/she would find the game. Within this activity, it is suggested that in order to train inhibitory control, the patient can be asked to clap their hands every time they see something irrelevant (such as an advertisement, spam or a step that is of no interest).
Rationale	In order to intervene on selective attention, we propose a task that trains visual tracking and tracing, which would also stimulate processing speed. The patient will also have to make use of the conceptual transfer that we trained previously so that he/she intuits that the search engine can be used for different tasks. He/she will also have to visually track the screen, focus his/her attention selectively to choose the right steps to achieve the goal and finally control interference and inhibit stimuli that are irrelevant (such as spam or advertisements). The game itself trains selective attention, as it is the classic game of finding differences between two images (this same task can be done instead of a Facebook game, with published photos of a friend).

Example:

a. 

b. 

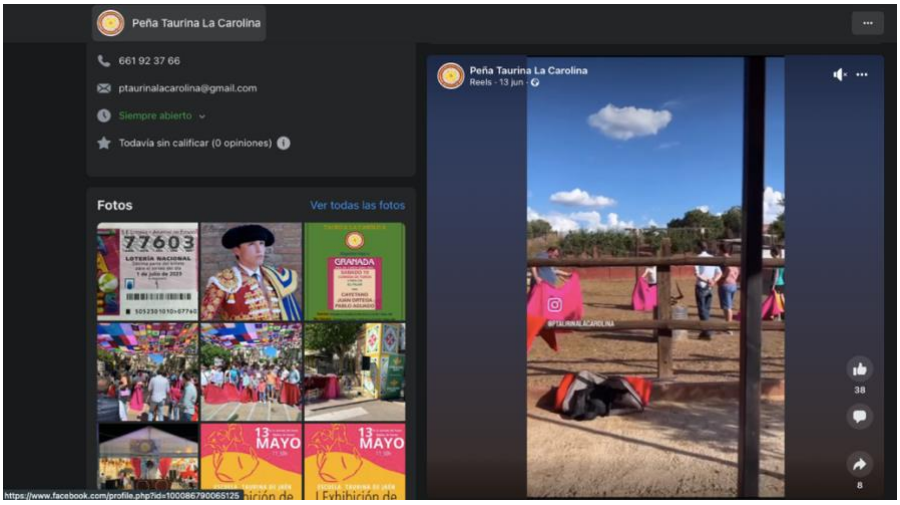
c. 

Note. The example shows (a) the hint provided to the patients in order to find the game, (b) instructions showed at the beginning of the game and (c) the dynamic of the proposed game that consists in finding the differences between two pictures as fast as possible.

SESSION 11
Attentional control

Target	The aim of this session is to finalize the training of attentional control, intervening on the executive sub-processes of monitoring and self-regulation.
Task	In the activity, it is proposed to the patient that for the session, their task will consist of reading or visualizing for one minute of time information on a topic opposed to their beliefs and according to the patient's interests (news, comments from a group or page, videos, etc.). If the patient does not know how to choose a topic, the researcher can provide him/her with some topics to choose from. Therefore, the patient will be asked to write down something that summarizes everything they have read, an opinion or comment that they are against, and return to the content for 1 minute.
Rationale	At the beginning of the session, it will be explained to the patient that the researcher will not be supervising the session, but that he/she will have to control the time, monitor if he/she makes any mistakes and regulate him/herself emotionally so as not to get too upset.

Example:

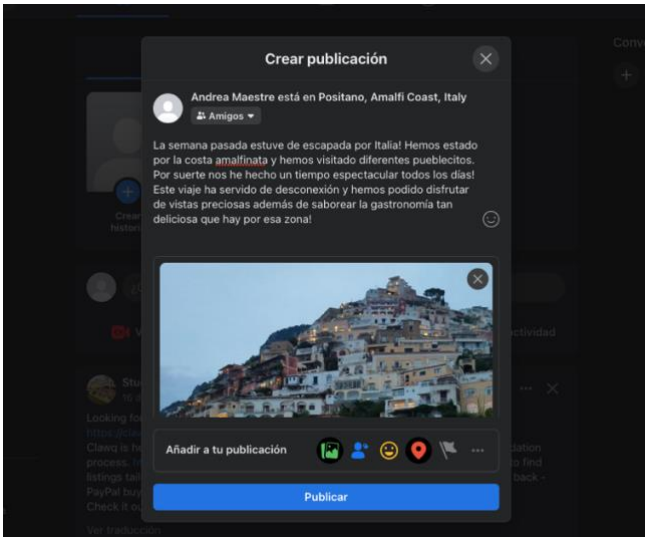
a. 

Note. The example shows (a) in case the patient is against bullfighting, a page or group of bullfighting fans must read. Also, watching a video about bullfighting for a minute can be suggested.

SESSION 12
Information processing

Target	This task seeks to intervene on the sub-processes of speed, efficiency and fluency of information processing.
Task	As a final activity, the patient is given 5 minutes to select all the material or content they wish to upload. Once selected, they will have to describe as quickly as possible everything that is in the content they want to share (for example, if it is a photo, describe who appears, where it was, when, why they want to upload it, etc.).
Rationale	In addition to intervening on information processing, this exercise will train the retrieval of semantic and episodic associations related to the content to be uploaded, as well as selective attention and inhibitory control by enhancing visual scanning.

Example:

a. 

Note. The example shows (a) how uploading content is presented in the platform. Here, the patient can write a footnote or description of the material, apart from adding the location, mentioning friends that appear in the content, adding different photos and videos on a row, choosing whether the post will be public or only for friends…

Post-intervention (sessions 13-15)

At the conclusion of the treatment sessions in each group, the same instruments and standardized neuropsychological tests administered in the *Pre-intervention* will be administered again. The aim is to observe whether the potential effect (or difference between scores) found between pre-treatment and post-treatment depends on on the assigned group, thus determining the efficacy of the proposed intervention. This procedure will be carried out by R2 (same blinded expert as in the first evaluation) over a period of three sessions 45 minutes each, spanning two weeks.

2.5. ETHIC AGREEMENT

The procedure used will obtained the approval of the Ethics Committee of the University of Granada for human research and the informed consent of each patient (see Annex I).

2.6. STATISTICAL ANALYSES

To perform the statistical analysis of the data, a descriptive analysis of the variables measured in the sample will be carried out in the first place. This analysis will involve calculating the means and standard deviations for the quantitative variables (neuropsychological test scores, age and time of evolution of the ABI), and frequencies for the qualitative variables (sex, educational level, follow-up or not of medication). This step aims to control and identify any notable variables that may be relevant to the study, and to ensure that there are no significant differences between the groups and that they are therefore well-matched and equal. In this way, it will be possible to determine whether the beneficial effect obtained from the intervention program is due exclusively to the proposal or to other variables that may influence it.

Next, a repeated measures MANOVA design (Multivariate Analysis of Variance) will be employed, as multiple DVs are being considered. The analysis will involve comparing two groups (experimental and control) at four assessment moments (pre- and post-treatment) for each of the independent variables. In the event that any of the comparisons yield significant results, the corresponding post-hoc tests will be carried out, with a significance level set at $p < 0.05$. In this way, this approach will allow for the evaluation of the effects of the Facebook-based intervention program on the cognitive domains being assessed.

3. RESULTS

The study will be brought about with a sample of 24 adult patients and, including that the prevalence of ABI indicates a slight predominance in women (although it is fairly balanced), it would be expected to find a similar proportion in the proposed sample (i.e. 13 women and 11 men approximately). Taking into account that the age range considered for the research is 18 to 65 years, it is estimated that the mean age would be 41.5 years. Given that the score in the INECO IFS would be a filtering factor to be part of the study population, the average score obtained will be below the cut-off point.

Once the necessary statistical analyses have been performed, significant interactions are expected to be observed among the different IVs (EG or CG, and assessment time point) and the DVs (scores on neuropsychological tests assessing the four executive components, social skills, and memory). In the following, the expected results pre-intervention for each group will be presented according to each DV measured (the comparison of pre and post results are described in the *Expected Post-Intervention Results* graphs*)*.

We will discuss the different component of **EFs** in the first place. Regarding the cognitive flexibility sub-process, in an initial evaluation (see Assessment instruments used for pre-treatment measures) it is estimated that both treatment groups will exhibit poor performance mainly in working memory and divided attention. This manifests as a low capacity to retain, store and manipulate information, as well as difficulties in distributing attention among multiple stimuli simultaneously. On the other hand, patients are initially expected to present in the pre-treatment measures of the attentional control component, a low ability to selectively attend to specific stimuli and inhibit responses, as well as to sustain attention for a prolonged period of time. In the first assessment of goal setting, difficulties in anticipation, formulation and development of steps to achieve a goal, as well as in the inability to organize complex information or to sequence a strategy for problem solving are expected to be observed in both EG and CG, all reflected in low performance and low scores in the neuropsychological assessment tests. Finally, Pre- treatment measures of these tests in the information processing component in both groups, will show a slowing of information processing, as well as lower scores on tasks or tests requiring rapid information processing and response, which may in turn, affect fluency, efficiency and decision making.

Taking into consideration other cognitive domains, **memory function** will be measured through the standardized tests TAVEC (verbal memory) and ROCF (visual memory). Even though memory is not the principal aim of this intervention, it is expected to see low scores in pre-treatment measures for both groups, given that it is commonly seen that these patients would present difficulties in retaining and recalling new information, as well as in retrieving previously stored information, affecting the processes of encoding, storing and remembering information (FEDACE, 2016). Lastly, with respect to **social skills**, in an initial assessment, participants in both the EG and CG, will exhibit similarly low scores on the Social Skills Scale, since patients with ABI are characterized by a decreased ability to interact effectively and appropriately with others in social situations.

When analyzing the results obtained from the initial neuropsychological assessment across the different domains, it is worth highlighting that no significant differences will be

found between the EG and CG, indicating that therefore, both groups will present similar scores in terms of poor performance on the administered tests.

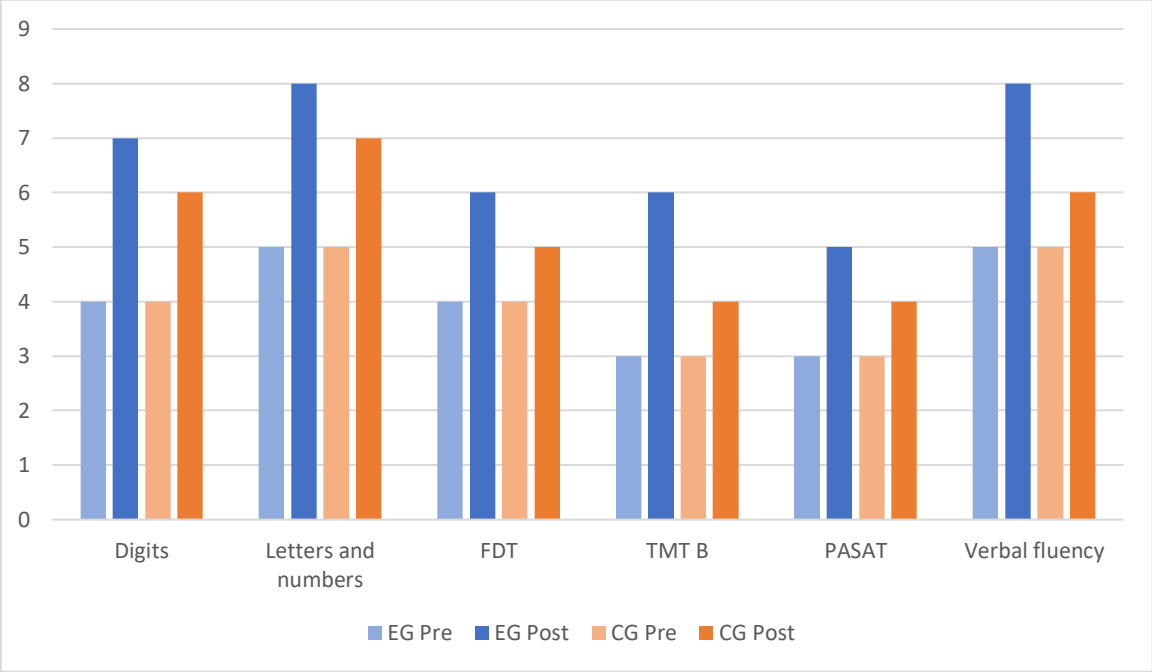
Hereafter, we will proceed to discussed the expected results post-intervention, beginning with **EFs** in the first place.

Cognitive flexibility:

Following the completion of the 12 treatment sessions and based on the existing literature, it is expected to observe significant differences between both groups in the cognitive flexibility component (Figure 5). Specifically, the EG is anticipated to experience considerable improvement in their ability to perform tasks reliant on working memory (such as in particular the WAIS-IV inverse digit span and letters and numbers, or in PASAT), divided attention and alternation (specifically TMT part B, verbal fluency and FDT in the alternation and flexibility index) compared to their performance prior to receiving the treatment (at the pre-treatment level). However, it is expected that the CG will demonstrate a slight improvement in this executive component compared to their performance in the pre-assessment phase, albeit to a lesser extent than the EG. This is because, although they were not exposed to the proposed intervention program, they followed the neuropsychological rehabilitation program proposed by the center Sinergia.

Figure 5

Scalar score of the Cognitive Flexibility assessment tests



Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group; Digits, WAIS-IV digit subscale; Letters and numbers, WAIS-

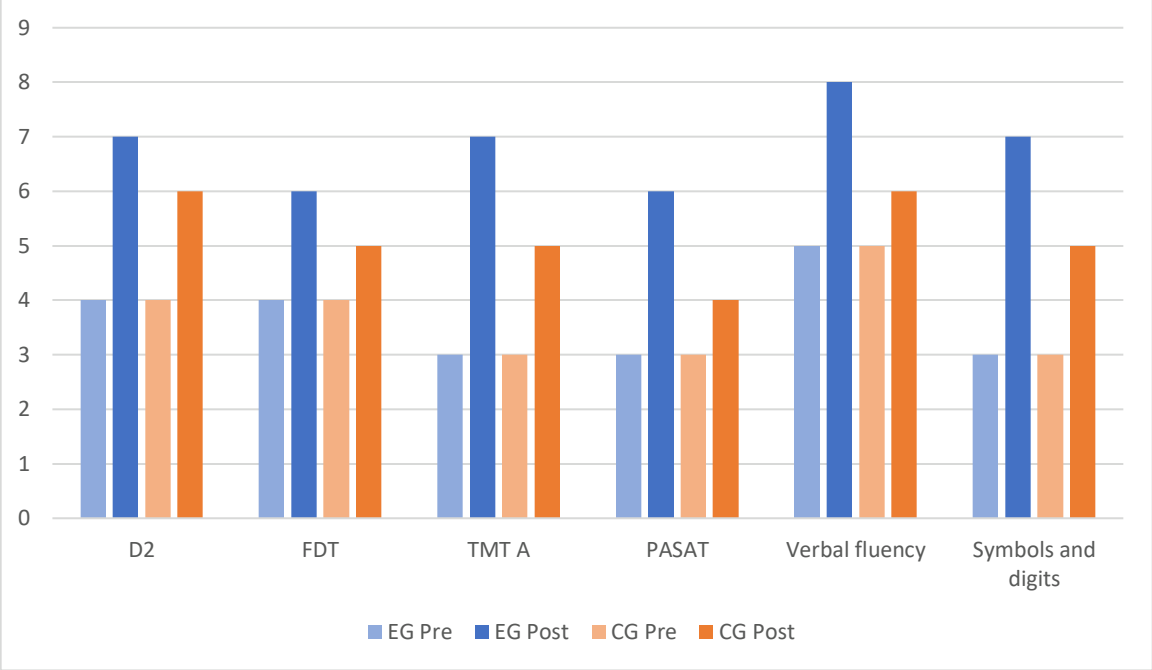
IV Letters and Numbers Subscale; FDT, Five Digit Test; TMT B, Trail Making Test part B; PASAT, Paced Auditory Serial Addition Test; Verbal fluency, verbal fluency test.

Attentional control:

After the implementation of the intervention programme, the experimental group is expected to significantly increase their performance in tests measuring the attentional control component (Figure 6), particularly selective attention and inhibition. Specific tests assessing these aspects include the TMT part A, the choice and alternation index of the FDT, D2 or Symbol and Digit test. Compared to the pre-treatment measures (and to the CG), it is anticipated that the EG will enhance their ability to control interference, focus their attention and inhibit information that interferes with the correct response. In the case of the D2 test, it is particularly expected that the number of commissions errors committed by patients will decrease, as their inhibitory control is expected to improve significantly after the intervention (although a decrease in omissions errors can also be found as evidence of an improvement in selective attention). On the other hand, as for the control group, is also expected to demonstrate better performance on these types of tests compared to the pre-measures, although not as significantly as will be observed in the EG.

Figure 6

Scalar score of the Attentional Control assessment tests



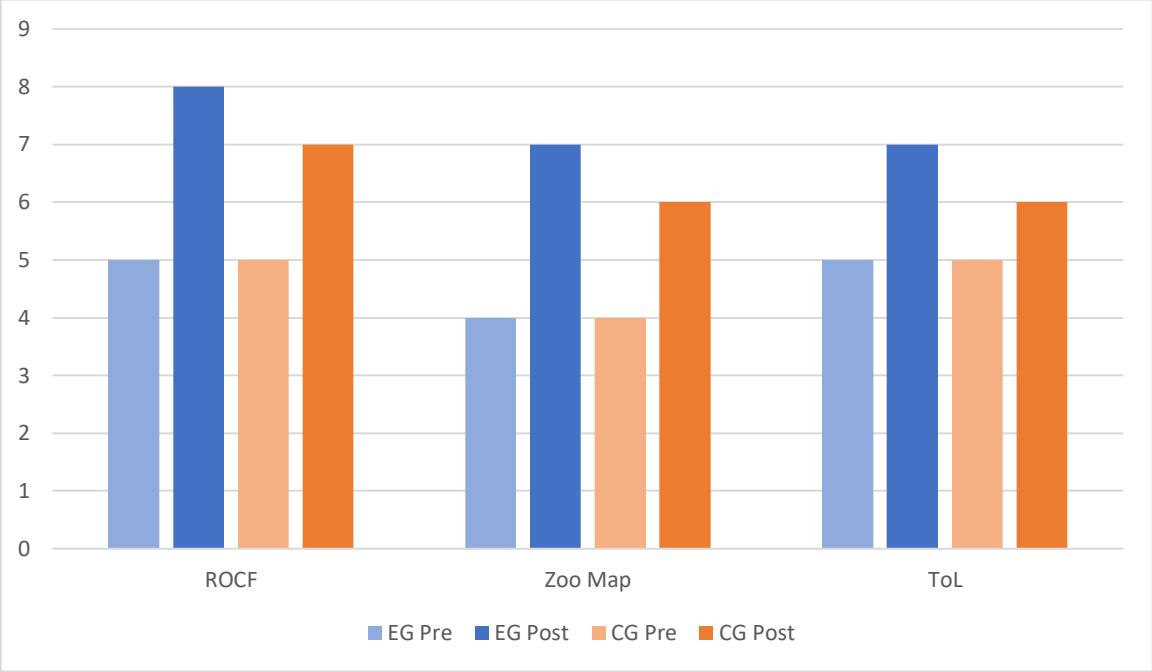
Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group; D2, d2 test; FDT, Five Digit Test; TMT A, Trail Making Test Part A; PASAT, Paced Auditory Serial Addition Test; Verbal fluency, verbal fluency test; Symbols and digits, WAIS-IV Symbol and Digit Test.

Goal setting:

In the post-treatment measures, following the completion of the intervention program, it is expected that the EG will show a significant increase in performance and scores on tests assessing all sub-processes of the goal setting executive component (Figure 7), compared to pre-treatment measures and to the CG. The intervention is assumed to promote and enhance a significant growth in the number of strategies used for task solving, as well as an increased ability to anticipate information oriented and relevant to future executions. This improvement will be reflected in the scores of, in particular the Zoo Map part A, the total and correct movements of the ToL, and the copy task of the ROCF. Since the intervention can be tailored to the patient's particular tastes and preferences, the program itself will enhance the patients' initiative, as it is closely related to motivation, driving and directing behavior towards a desired goals or outcome. Finally, as for the control group, no significant differences are expected to be found compared to the initial evaluation, but there would be positive changes in terms of the participants' planning strategies.

Figure 7

Scalar score of the Goal Setting assessment tests



Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group; ROCF, Rey-Osterrieth Complex Figure; Zoo Map, Zoo Map Subtest of the BADS Battery; ToL, Tower of London.

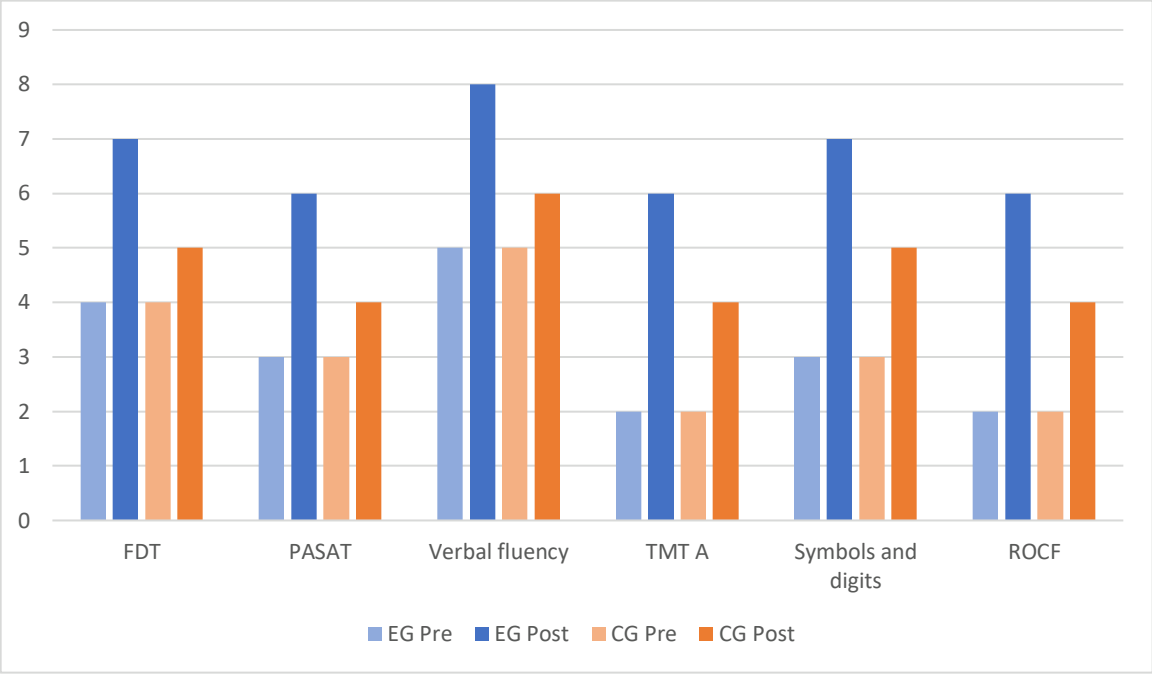
Information processing:

At the end of the intervention program, in the post-treatment measures of the information processing executive component (Figure 8), the EG is expected to increase their

speed as well as the fluency and efficiency of information processing due to the executive demands of the proposal in relation to this component. This will be reflected in an increase in tests scores, specifically in the reading index of the FDT test, in the TMT part A time and in the Symbols and Digits test (compared to the same instruments' scores from the pre-treatment measurement). Similarly, an improvement of this executive component is expected to be observed in the CG compared to the pre-treatment assessment due to the center's intervention programme, although to a lesser extent. It is worth noting that significant differences are also expected to be found between the experimental group (EG) and the control group (CG).

Figure 8

Scalar score of the Information Processing assessment tests



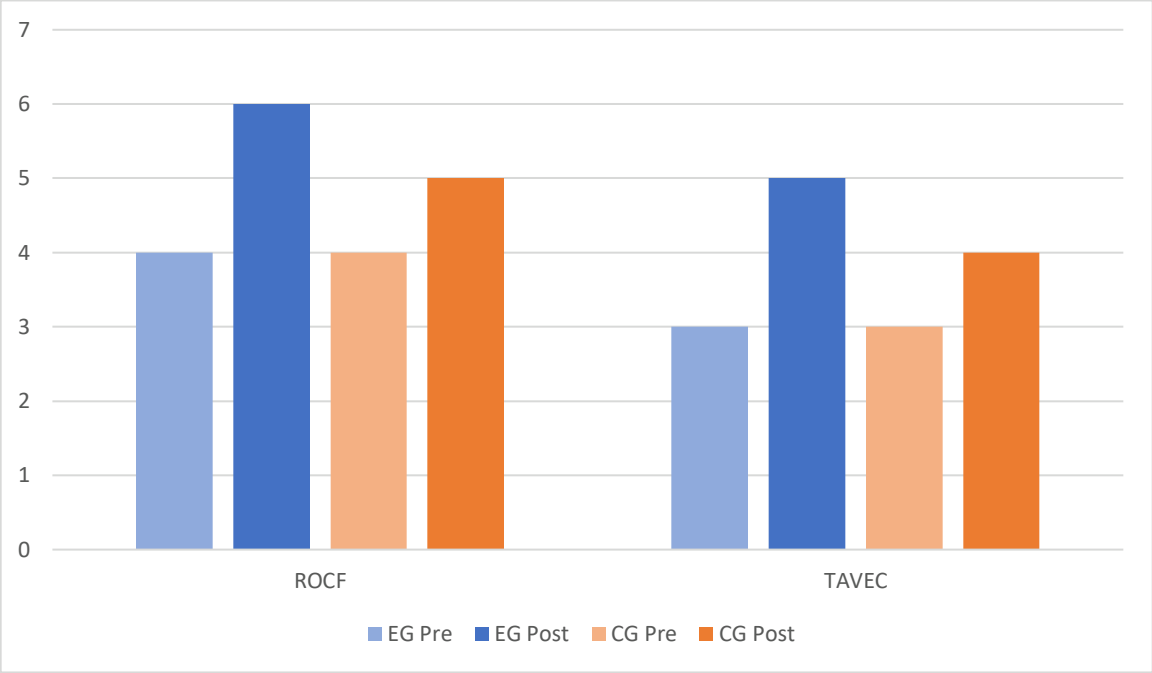
Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group; FDT, Five Digit Test; PASAT, Paced Auditory Serial Addition Test; Verbal fluency, verbal fluency test; TMT A, Trail Making Test part A; Symbols and digits, WAIS-IV Symbol and Digit Test; ROCF, Rey-Osterrieth Complex Figure.

In terms of **memory function**, it is estimated that significant and considerable improvements will be observed in the post-treatment measures for the EG compared to the pre-treatment measures within the group and to the CG (Figure 9). This is specifically reflected in long-term recall (although to a lesser extent in short-term recall) of the visual material presented in the ROCF. Additionally, an upward learning curve is expected to be observed in the TAVEC test across trials, along with improved performance in short- and long-term recall (both free and cued). As for the CG, which participated exclusively in the neuropsychological rehabilitation program focused on the EFs, no significant differences

would be found in this cognitive domain compared to the first evaluation. Nevertheless, there would be positive changes in the scores, especially in ROCF test compared to TAVEC, since despite not explicitly targeting the memory, other executive components relevant to the great performance of the test, such as planning, organization, selective attention and information processing, will be trained (Allen et al., 2012; Castrillón, 2019).

Figure 9

Scalar score of the Memory assessment test

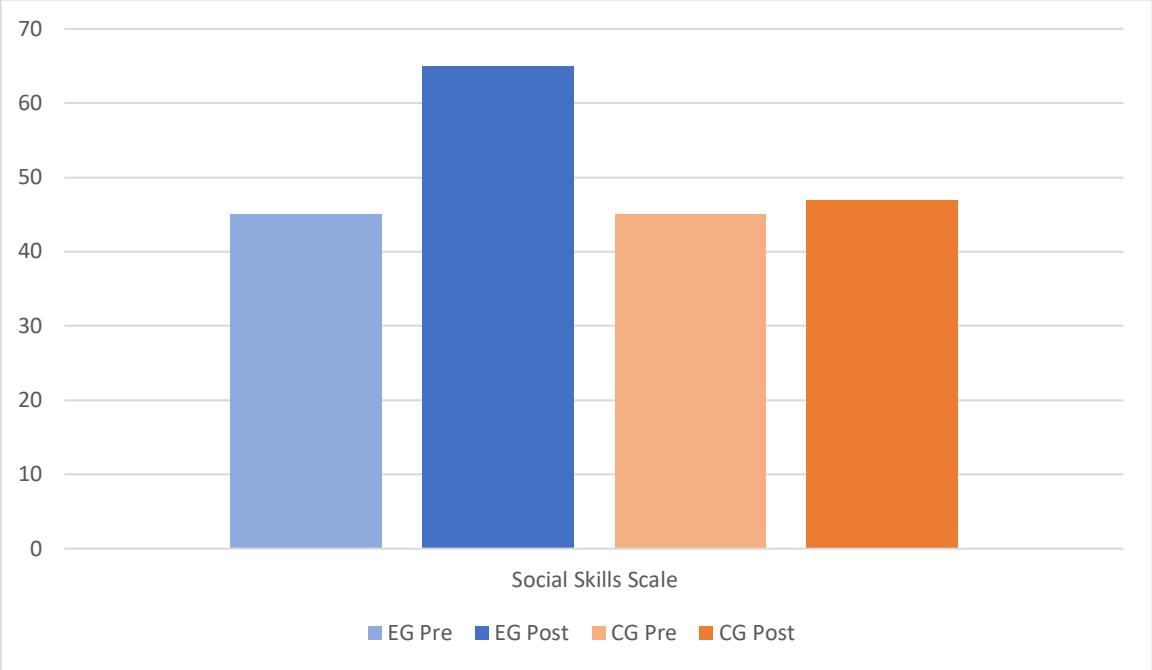


Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group; ROCF, Rey-Osterrieth Complex Figure; TAVEC, verbal learning test.

Finally, in relation with **social skills**, after the proposed intervention and in comparison to the pre-treatment measures, a significant improvement in the neuropsychological test is expected to be observed in the EG (Figure 10), following an enhancement of communication skills, pro-social behavior and a better interpretation of social contexts. However, in the CG, an increase and positive changes in social skills performance are expected due to the nature of the program proposed by the center, although not as significant.

Figure 10.

Percentile obtained by each group on the Social Skills Scale



Note. EG Pre, pre-treatment measures of the experimental group; EG Post, post-treatment measures of the experimental group; CG Pre, pre-treatment measures of the control group; CG Post, post-treatment measures of the control group.

4. DISCUSSION

To date, ABI is a highly prevalent problem in the population (FEDACE, 2016), with cognitive impairments, particularly in EFs, being the most disabling issue for these patients. Therefore, there is a need for neuropsychological treatments that take into account these complaints, have a long-term efficacy, and above all, that effectively target the functional problems that impact their ADLs. While process-based neuropsychological rehabilitation has proven effectiveness, it has limitations that may restrict therapeutic effects, such as the lack of ecologically-based cognitive tasks or training based on ADLs. SNs, although commonly used superficially by the population for leisure or entertainment purposes, can provide new resources and tools for neuropsychological training and improvement of EFs in these patients (Kieling et al., 2017; Myhre et al., 2017; Quinn, 2018; Rute-Pérez, 2018; Sörman et al., 2017; Yildirim & Obel-Balaban, 2021). Therefore, this intervention proposal aims to, on the one hand, compare the effectiveness of neuropsychological training and rehabilitation based on SNs (using the tools offered by the Facebook platform) for the improvement of EFs and, on the other hand, to indirectly enhance the social skills and memory functions of these individuals.

Previous literature has already emphasized that processes such as working memory, divided, alternating and selective attention, inhibitory control, social skills, episodic memory

and processing speed can greatly benefit from the use and training of these aspects through the resources offered by SNs and specifically Facebook (Brunner et al, 2020; Kieling et al., 2017; Lara & Bokoch, 2021; Myhre et al., 2017; Quinn, 2018; Sörman et al., 2017; Yildirim & Obel-Balaban, 2021). For this reason, it is estimated that the neuropsychological intervention will be effective in improving the performance of the targeted intervention domains, as reflected by an increase in scores on the administered neuropsychological assessment tests, compared to the group that undertake a process-based neuropsychological rehabilitation programme.

Although our sample size is small, it is representative of the target population of our study, as it exhibited common characteristics among individuals with ABI in terms of gender, age, symptomatology, etiology and other relevant factors (FEDACE, 2016; González, 2014; Hoyas et al., 2015; Ríos-Lago et al., 2008; Rubio & Atarés, 2019).

Therefore, in the baseline assessment, it is expected that there will be no significant differences between the EG and CG, and therefore both groups will be homogeneous, similar and with the same cognitive profile. Taking this into account, it is predictable that the scores on the instruments used for the pre-treatment measures will reflect similar difficulties in both groups in all the executive components described by Anderson (2002): cognitive flexibility, executive control, goal setting and information processing, as previous research on ABI has already shown these types of deficits (De Noreña et al, 2010; González et al., 2014; Hoyas et al., 2015; Martínez et al., 2021; Ríos-Lago et al., 2008; and Rubio & Atarés, 2019). On the other hand, low performance in social skills and memory is also expected, according to the instruments used to assess these cognitive functions (Brunner et al., 2022; De Noreña et al, 2010; FEDACE, 2016; González, 2014; Hoyas et al., 2015; Martínez et al., 2021; Myhre et al., 2017; Quinn, 2018; Ríos-Lago et al., 2008; and Rubio & Atarés, 2019; Tsaousides et al., 2011; Yildirim & Obel-Balaban, 2021).

The following outlines the intervention that will be implemented by both groups. The rehabilitation for the CG will consist of the neuropsychological treatment program focused on EFs proposed by the center, which will comprise a total of 9 sessions lasting 45 minutes each, with a duration of 5 weeks. In contrast, the EG, in addition to following the same program designed for the GC, will be supplemented with the treatment proposed in this study based on Facebook tools. When applying the intervention, no difficulties are expected to be encountered by the patients in terms of administration, follow-up or performance of the suggested activities, as it is anticipated that they have prior experience with the platform to ensure their commitment and familiarity with Facebook tools. It should be noted that the proposed treatment is similar to previous research (Lara & Bokoch, 2021; Milovich & Burleson, 2020; Myhre et al., 2017; Quinn, 2018; Rute-Pérez, 2018; Yildirim & Ogel-Balaban, 2021), although at the methodological level, differences can be found (implementation on different platforms or different procedures in the control group). Nevertheless, it is predicted that a comparable performance of the sample in the proposed implementation will be observed in comparison to similar ones.

Indeed, at the end of the proposed treatment and after analyzing and comparing the results of the patients using neuropsychological measures in the pre- and post-treatment assessments, a significant and primary improvement can be observed in the discussed

executive components, as well as a secondary enhancement in social skills and memory abilities for both groups. However, discrepancies are expected to be found between both groups, indicating that the pattern or profile of improvement will not be the same between them, as a greater increase from the EG in post-treatment scores is anticipated compared to the GC. Specifically, and in line with the proposed hypotheses, a significant improvement will be observed by the EG mainly in the executive components of cognitive flexibility, attentional control, goal setting, and information processing (in a consistent way), as well as in other cognitive functions such as memory and social skills (Brunner et al., 2015; 2022; Khoo & Yang, 2020; Kieling et al., 2017; Lara & Bokoch, 2021; Meshi et al., 2016; Milovich & Burleson, 2020; Miropolsky et al., 2020; Myhre et al., 2017; Quinn, 2018; Rute-Pérez, 2018; Sörman et al., 2017; Yildirim & Obel-Balaban, 2021). For the control group, although positive changes in the scores of the executive component assessment tools are predicted, no significant improvements are expected after the implementation of the neuropsychological rehabilitation program. With regard to other cognitive processes, in this case memory, no significant improvements in this function are anticipated, although a slight increase is likely to be found due to the relationship between the stimulation of executive sub-processes such as organization, planning, selective attention, and information processing, with memory retention and retrieval (Allen et al., 2012; Castrillón, 2019). On the other hand, social skills are not expected to increase significantly either. However, if slight improvements are observed, they may be attributed to the fact that the treatment takes place in a social context (a center with other patients, professionals, etc.) that can stimulate communication skills or the generation of interaction strategies with peers, but not to the rehabilitation program itself.

All of this would indicate that the objectives suggested in our study have been met, and therefore, the neuropsychological treatment based on the use of Facebook accompanied by a rehabilitative program targeting neuropsychological processes is more effective than the rehabilitation offered by the center alone in reducing the executive symptoms characteristic of patients with ABI (although both interventions would lead to a decrease in these deficits).

This effectiveness has already been observed in previous research following similar interventions. Regarding EFs, based on studies conducted by Yildirim and Obel-Balaban (2021) and Quinn (2018), an increase in the performance of the *cognitive flexibility* component will be noted in patients from the group trained using Facebook, suggesting an association between active use of the platform and better performance in this executive function tasks that mainly assess working memory, semantic fluency, information updating, and divided attention. This increase in the aforementioned executive subprocesses would be reflected in higher scores in the post-measures of FDT tests, WAIS-IV digit and letter-number subtests, TMT part B, PASAT, and verbal fluency test. All of this can be explained by the fact that content generated by other users, appears in the Facebook news feed, as it is being published, forcing participants to filter these changes, read and respond to them, thereby updating working memory (Myhre et al., 2017). In relation to *attentional control*, authors such as Lara and Bokoch (2021), Meshi et al. (2016), and Quinn (2018) have demonstrated an enhancement in this executive component, specifically at the level of increased inhibitory control and selective attention, given that to use this platform effectively,

due to the large amount of information presented, it is necessary to filter attention to relevant information flows and discard irrelevant ones. These enhancements would be reflected in the scores of instruments such as d2, FDT, TMT Part A, PASAT, verbal fluency, and symbol-digit tests at the post-treatment level. Furthermore, several authors have also demonstrated an increase in *goal-setting* following the use of Facebook. Patients, in order to make judgments and carry out an action plan aimed at the desired stimulus or objective, need to direct their attention to multiple stimuli, subsequently triggering executive subprocesses such as initiative, reasoning, organization, and planning (Lara & Bokoch, 2021; Meshi et al., 2016; Miropolsky et al., 2020; Reed, 2023). Therefore, it is expected that improvements in the scores of the ROCF, Zoo Map Test, and ToL Test will be observed after the intervention. Lastly, the increase in *information processing*, specifically the speed of this executive component after the use of SNs, is also supported by the study conducted by Milovich and Burleson (2020), who identified an improvement in this subprocess reflected in higher performance on the FDT test. Additionally, in this proposal it is anticipated that there will be improved performance on the PASAT, verbal fluency, TMT part A, symbols and digits, and ROCF tests. Similarly, a study by Myhre et al. (2017) associated the use of Facebook with a beneficial effect on processing speed, linked to improvements in visual scanning and selection processes, which are necessary in Facebook tasks to locate and select relevant icons among various distractors. This can be explained by the fact that when implementing tasks with limited execution time, patients must progress and organize themselves at their own pace, thereby promoting not only processing speed but also working memory, planning, initiative, and perceptual reasoning (Myhre et al., Yildirim & Obel-Balaban, 2021).

To conclude the evidence on EFs, the studies conducted by Khoo and Yang (2020) have linked the overall improvement in executive components following the use of Facebook with an increase in perceived social support by the patients. By using this platform, patients interact with their family and friends, which positively predicts executive functioning indirectly through perceived social support. Therefore, according to the authors, it is important to consider the mediating role of perceived social support in patients, as it influences, among other factors, the alternating and inhibitory aspects of executive functions (Khoo & Yang, 2020). Furthermore, concerning *social skills*, the expected increase in the Social Skills Scale scores is mainly attributed due to the fact that Facebook, as a SNs, implies in itself, in addition to the objective executive training of the intervention, the promotion of understanding and use of social signals, as well as the capacity for emotional regulation, verbal and non-verbal communication, conflict resolution, and adaptation to different social contexts (Brunner et al., 2015; 2022). Lastly, according to previous studies, a possible explanation for the indirect improvement in *memory functions* would be that by expanding the social skills of patients (as well as their verbal abilities) and incorporating their own interests and hobbies into the intervention, it would help them access information about the past or current events, thereby stimulating their memory (specifically episodic memory) (Milovich & Burleson, 2020; Sörman et al., 2017). Furthermore, a relationship has been found between improved performance in executive function tasks and an increase in short-term memory in the aspect of semantic processing, so it is expected to observe gentle positive changes in both memory evaluation tests, albeit slightly higher in the ROCF compared to the TAVEC (Allen et al., 2012; Castrillón, 2019).

After concluding the intervention proposal, it is necessary to mention some of the **limitations** encountered, as well as suggest improvements and approaches for future work in order to plan new studies and new lines of reflection regarding ABI. Firstly, this proposal does not consider a follow-up or monitorization of the patients' therapeutic progress after the intervention, meaning that the short-term use of SNs may have a limited effect on EFs, since the changes in perceived social support promoted by these platforms (which, in turn, have been found to be a mediating element of EFs performance) require time to establish and demonstrate their full therapeutic effects. Secondly, in the sample selection process, the patients participating in the research are selected on the basis of having impairments in EFs, but the potential comorbidity with other neuropsychological disorders is not taken into account, nor is the specific type of ABI distinguished as an exclusion criterion. Lastly, all the tasks proposed in this intervention target different executive components, but the expected effects at the neuroanatomical and functional level cannot be contrasted, thus the inclusion of neuroimaging measures would be advisable.

Despite the limitations identified, the suggested research has several positive aspects and **advantages** that should be taken into consideration. Firstly, unlike similar previous proposals, the intervention focuses on specific executive sub-processes rather than considering EFs as a unidimensional construct. Secondly, the use of SNs, specifically Facebook, as a treatment method represents a novel and interesting approach compared to other proposals or intervention tools. In recent years, neuropsychology professionals have sought non-traditional approaches involving activities that patients can engage on a daily basis, that are ecologically valid and that can also improve their cognitive functions, making SNs a good alternative. In addition, interventions are typically conducted individually or in groups, however, this innovative approach provides professionals with an activity that patients can perform in both modalities and with desired frequency. Furthermore, as previously mentioned, the platform itself offers a range of advantages that are challenging to find in other traditional neuropsychological rehabilitations, such as low cost, wide and easy accessibility, social support and motivation enhancement, flexibility in scheduling and location, diverse resources, possibility of receiving feedback, adaptability to different profiles and needs, continuity, and intervention monitoring, among others.

Finally, regarding **implications and future research**, it is suggested, first of all, that the intervention extends the use and training based on SNs for a minimum of 4 months (with ongoing patient’s monitoring) in order to study the maintenance of treatment effects and to assess long-term effectiveness by carrying out a longitudinal study. Following, it could be highly interesting to explore this proposal with patients who have deficits beyond executive functions, such as those with praxis, visuospatial, and/or visuoperceptual impairments, aphasia, and/or neglect. Specific adaptations of the treatment steps would be necessary in these cases. Namely, patients with neglect may benefit greatly from this type of rehabilitation, as SNs would stimulate selective attention and visuospatial abilities by requiring visual tracking to explore and process visual information presented on the screen (e.g., images, text, videos). However, it is important to be borne in mind that, that it would be necessary to adapt the layout of the interface and the design of the applications, as these can influence how individuals with neglect interact with the information presented (e.g., if the majority of relevant elements are located on the neglected side, individuals may have

difficulties detecting and processing them). Furthermore, for future lines of research, it is suggested to include in the neuropsychological assessment, instruments that measure patients' performance in activities of daily living (ADLs), such as the Scale of Basic and Instrumental Activities of Daily Living by Rodríguez-Bailón et al. (2015), in order to compare post-treatment results and determine whether this intervention affects their daily functionality. Lastly, it would also be interesting to consider suggesting this type of intervention for adolescent patients with neurodevelopmental disorders, as they often exhibit difficulties in inhibitory control, attentional control, low planning and strategic organization, and other executive aspects, and they could therefore benefit from these tools.

5. CONCLUSION

Neuropsychological rehabilitation of EFs in adults with ABI using a process-based approach, coupled with a treatment proposal that incorporates executive training using Facebook resources, will result in a more notable and effective improvement in the selected executive components. The striking and innovative aspect of this intervention is that, compared to other rehabilitation approaches, it offers numerous advantages due to the diverse benefits provided by this platform in terms of accessibility, cost, and cognitive transfer, among others. Further research aimed at testing and comparing the effectiveness of therapeutic use of Facebook against other established interventions, would be advisable in order to identify the most suitable techniques for addressing ABI.

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ANNEX

ANNEX I
INFORMED CONSENT

Mr./Ms _____, with ID/Passport nº _____.

I declare that:

- I have received all necessary information regarding the nature and purpose of the study in which I will be participating.
- I have asked the questions I considered necessary and resolved any doubts about the objectives and procedures to be followed throughout the study in a satisfactory manner.
- I have been informed that all personal data and information collected during the conduct of the study will be kept confidential and will not be used for any purpose other than the purpose of the study, and will therefore be appropriately protected.
- I understand that my participation is voluntary and I may revoke my consent at any time without giving any reason.

Taking all of the above into consideration, I GRANT my CONSENT for the participation in the following study.

Date: _____

Signature: _____