Archives of Clinical Neuropsychology, 2025, **40**, 842–857
https://doi.org/10.1093/arclin/acae114
Advance access publication date 16 December 2024
Original Empirical Article

The Moderating Role of Online Awareness in the Association between Strategy Use and Performance Accuracy on a Test of Functional Cognition in Individuals with Acquired Brain Injury

Daniel Salazar-Frías[1,*], María Jesús Funes[1,†], Ana Clara Szot[2], Lucía Laffarga[1], Alba Navarro-Egido[1], María Rodríguez-Bailón[2,†]

[1]Mind, Brain and Behaviour Research Centre (CIMCYC), Experimental Psychology Department, School of Psychology, University of Granada, Campus de Cartuja s/n - 18071 Granada 18011, Spain
[2]Physiotherapy (Occupational Therapy) Department, Health Science School, University of Málaga, Málaga 29071, Spain, 29071

[*]Corresponding author at: Mind, Brain and Behaviour Research Centre (CIMCYC), Experimental Psychology Department, School of Psychology, University of Granada, Campus de Cartuja s/n - 18071 Granada, Spain. Tel.: +34 958 245168.
E-mail address: dsalazarfrias@ugr.es, dsalazarfrias@gmail.com (D. Salazar-Frías).

[†]These authors have contributed equally to this work and share senior authorship.

ABSTRACT

Objective: Deficits in online self-awareness (SA) are common after acquired brain injury (ABI), leading to safety concerns and impacting daily activities and rehabilitation outcomes. Early identification is recommended as a critical first step in cognitive rehabilitation following ABI. The aim of this observational study was to examine differences in online SA and strategy use between individuals with ABI and healthy controls. It also investigated whether online SA moderates the relationship between strategy use and performance accuracy on a test designed to assess cognitive-functional deficits.

Method: 80 individuals with ABI and 76 controls completed the Spanish Weekly Calendar Planning Activity-10. Measures of online SA included strategy use and self-recognized errors assessed during task. An after-task interview assessed individuals' self-evaluation of task difficulty and accuracy of performance.

Results: Individuals with ABI performed worse than controls on most measures of online SA. They were less likely to self-recognize errors and use self-monitoring strategies. They also tended to overestimate their performance and showed greater discrepancy between self-rated and actual performance. Moderation analyses show that better performance was significantly associated with greater strategy use among ABI individuals who were aware of their performance.

Conclusions: Online SA appears to moderate the use of cognitive strategies during functional cognitive performance after ABI. Therefore, it is important to include assessments of online SA and strategy use for individuals with ABI. Furthermore, these findings highlight the importance of focusing on SA and self-generated strategies as key goals of cognitive rehabilitation aimed at improving daily functioning after ABI.

Keywords: Acquired brain injury; Online awareness; Everyday functioning; Cognitive rehabilitation; Cognitive strategies; Neuropsychology, cognitive assessment

INTRODUCTION

Impaired self-awareness (ISA) has been frequently reported following acquired brain injury (ABI) (Dockree et al., 2015a; Doig et al., 2017; Villalobos et al., 2019). Often, these deficits hinder individuals' ability to perform activities of daily living (ADLs), resulting in increased distress and caregiver burden (Prigatano, 2005; Toglia & Goverover, 2022). Thus, early detection is crucial for improving individuals' functional status (Bivona et al., 2020). To gain a better understanding of ISA as a clinical phenomenon, research has been focused on exploring the cognitive components that may underpin its complex nature. Toglia and Kirk (2000) proposed a multifaceted model with two main components. The first component is metacognitive knowledge (or general awareness), which is activated outside the context of a task and is related to beliefs and perceptions about one's cognitive abilities. The second component is online awareness, a

Received: August 14, 2024. **Revised:** November 15, 2024. **Accepted:** November 18, 2024

task-specific phenomenon that occurs at different stages of an ongoing task: (1) appraisal, anticipation, and prediction, which take place immediately before the task; (2) self-monitoring and self-regulation, occurring during the task; and (3) self-evaluation, after the task.

The importance of measuring self-awareness (SA) in clinical practice is widely recognized. Most SA instruments focus primarily on assessing its metacognitive component through interviews or self- and informant-based questionnaires (Fleming et al., 1996; Prigatano et al., 1986; Salazar-Frías et al., 2023b; Sherer et al., 1998). Conversely, recent reviews by Toglia and Goverover (2022) and Sansonetti et al. (2024) highlight challenges in measuring online SA, particularly due to the heterogeneity in the specific components under evaluation. For task appraisal, studies often asked individuals to rate task difficulty (Chen & Goverover, 2021; Mahoney et al., 2021) or estimate the number of errors before starting the task (Ricchetti et al., 2024a). Anticipation and prediction are usually assessed through self-predictions of errors, ratings of task success (Mahoney et al., 2021; O'Keeffe et al., 2007b; Ricchetti et al., 2024a), performance accuracy (Robertson & Schmitter-Edgecombe, 2015), or potential challenges that may arise (Bivona et al., 2020; Chen & Toglia, 2019; Merchán-Baeza et al., 2020). Self-monitoring and self-regulation are measured by the number of errors detected and corrected during tasks, respectively (Bettcher et al., 2011; Dockree et al., 2015a; Hart et al., 1998; Hoerold et al., 2013; Jaywant et al., 2022; McAvinue et al., 2005; O'Keeffe et al., 2007a; Ricchetti et al., 2024a). Lastly, self-evaluation involves self-ratings of task difficulty and success (Chen & Goverover, 2021; Jaywant et al., 2022; Morris et al., 2016; Ricchetti et al., 2024a), performance accuracy (Jaywant et al., 2022), or time required to complete the task (Chen & Goverover, 2021).

Various types of tasks have been used to examine different components of online SA. Some studies have used computerized tasks or cognitive tests (Dockree et al., 2015a; Hoerold et al., 2013; McAvinue et al., 2005; O'Keeffe et al., 2007a; Robertson & Schmitter-Edgecombe, 2015), while others have used performance-based tests of ADLs, such dressing, meal preparation, or wrapping a present (Arora et al., 2021; Bettcher et al., 2008; Chudoba & Schmitter-Edgecombe, 2020; Doig et al., 2017; Giovannetti et al., 2002; Hart et al., 1998; Ricchetti et al., 2024a; Ricchetti et al., 2024b).

Few of these studies using ADL performance-based tasks have examined the relationship between different cognitive processes and components of online SA, leading to mixed results. For example, Chudoba and Schmitter-Edgecombe (2020) found that in individuals with amnestic mild cognitive impairment accurate pre- and post-task predictions on the Day Out Task correlated more with executive function than with memory tests. In contrast, Chen and Goverover (2021) found no association between prediction accuracy on the Actual Reality functional task and tests of executive function in individuals with multiple sclerosis. Other studies by Bettcher et al. (2008) and Giovannetti et al. (2002) reported that reduced performance on executive function tests predicted poorer self-monitoring (i.e., error detections) and self-regulation (i.e., error corrections) in individuals with dementia, as demonstrated in the Naturalistic Action Test and the short form of the original Multi-Level Action Test, respectively. Ricchetti et al. (2024a) also observed an association between self-monitoring during the Breakfast and Dressing Conflict Task with a neuropsychological test of executive function, while self-evaluation was associated with short-term memory abilities. Overall, these inconsistences may be partly due to the fact that different clinical populations and different tests were used to investigate this relationship. To our knowledge, only Ricchetti et al. (2024a) have explored the relationship between specific executive and cognitive processes and distinct components of online SA (during and after task) in individuals with ABI. However, their study was preliminary, involving a small sample size. Furthermore, the ADL tasks they used, while executive in nature, were generally simple and familiar. This highlights the need for further research to examine the association between online SA and cognitive processes in more complex performance-based ADL tasks, particularly within this clinical population. These tests are generally considered more effective for exploring these relationships, as they allow clinicians to observe an individual's ability to detect and correct errors, as well as their perceived task difficulty (Sansonetti et al., 2024). Additionally, these tests con provide insight into the use of strategies and help identify common error behaviors contributing to performance deficits (Toglia & Foster, 2022).

Effective strategy use is crucial for normal cognitive and functional performance, as it helps to cope with complex situations (Toglia & White, 2020). In fact, using fewer or inefficient strategies has been associated with poorer performance in various clinical populations (Aronov et al., 2015; Geary et al., 2011; Kaizerman-Dinerman et al., 2019). However, despite their importance, there is currently a lack of clinical tools to formally assess their use in the context of instrumental activities of daily living (IADL). Schmitter-Edgecombe et al. (2014) examined strategy use in a sample of normal ageing adults and individuals with mild cognitive impairment and dementia using the Instrumental Activities of Daily Living – Compensation (IADL-C) scale, which captures self- and informant-reported use of compensatory strategies when performing various IADL. They found an increase in both self- and informant-reported strategy use for individuals in the mild cognitive impairment group compared to the healthy and dementia groups. Specifically, individuals with mild cognitive impairment used more strategies in response to perceived cognitive decline, whereas individuals with dementia found it difficult to use such strategies and/or recognized the need to use them. Similarly, Tomaszewski Farias et al. (2020) used the Everyday Compensation Scale (EComp), which is an informant-based questionnaire designed to measure compensatory strategies for performing IADL. They found that strategy use can minimize the effects of cognitive decline on IADL performance in older adults. While these studies confirm that strategy use increases the probability of successful independent performance, both self- and informant-based questionnaires are subject to reporter bias (Arora et al., 2021; Schmitter-Edgecombe et al., 2014).

Further examples come from studies examining the association between strategy use and functional performance-based tasks in individuals with ABI. Evidence for this comes from a recent study by Burns et al. (2020), who investigated whether strategy use in 23 individuals with stroke and 23 matched controls was associated with better performance on the Multiple Errands Test Home version (MET-Home) a test that aim to measure executive functions within the context of an IADL. Their results indicated that individuals with stroke who used planning strategies performed better on the MET-Home, while self-monitoring, multitasking, and environmental strategies showed no significant impact. In contrast, the control group showed significant associations between self-monitoring, multitasking, and environmental strategies, which were linked to overall improved performance on the MET-Home. Another study by Nott and Chapparo (2020) examined the role of cognitive strategies in daily functioning and participation among 16 individuals with ABI. Results from this prospective longitudinal study showed that more efficient and effective strategy use was associated with better scores on global measures of functional independence and community participation. Confirmation of this relationship is important, as it highlights the relevance of using methods that promote effective strategy use to improve functional performance after brain injury (Swanton et al., 2020). Indeed, previous studies have emphasized the importance of process-related variables, such as the total number of strategies used, in predicting real-world functioning (Schmitter-Edgecombe et al., 2021). It is therefore a clinical and research challenge to investigate what is needed to enable people with cognitive deficits to use effective strategies in order to carry out their daily tasks.

In this sense, recent research has identified various components of online SA as important prerequisites for independent strategy use in novel and complex tasks. For example, inaccurate task appraisal may lead to inaccurate judgments, affecting strategy selection and the cognitive effort exerted during task performance (Robertson & Schmitter-Edgecombe, 2015; Toglia & Goverover, 2022). Similarly, individuals who inaccurately self-evaluate task difficulty or success may not see the need to use strategies, which can pose safety risks and limit their independence (Ownsworth et al., 2006; Toglia & Kirk, 2000). In addition, independent strategy use may be influenced by self-monitoring and self-regulation skills. Previous work by Goverover et al. (2007) showed that effective strategies are more likely to be used when obstacles during performance of an activity are recognized. Indeed, failure to recognize and adjust to changes in everyday activities places individuals with ABI at risk of losing functional independence (Jeffay et al., 2023; Yeo et al., 2021). Although online SA appears to be important for effective strategy use, most of the supporting literature relies on quasi-experimental studies (van Erp & Steultjens, 2020) or studies on the effectiveness of interventions to improve online SA and functional outcomes (Nagelkop et al., 2021; Ownsworth et al., 2006, 2010; Toglia et al., 2010). Further empirical research is critical to explore online SA and strategy use within the context of ADL tasks, particularly among individuals with ABI (Toglia & Goverover, 2022). Additionally, there is a shortage of functional measures that consider an individual's awareness of their own performance and the use of strategies (Arora et al., 2021). Functional measures that take into account both strategy use and performance awareness in the context of more complex and cognitively demanding IADL can provide valuable insights into the real-life challenges faced by individuals with ABI, thereby improving treatment recommendations (Jaywant et al., 2022).

The 10-item Weekly Calendar Planning Activity (WCPA-10) is one of the few examples of an easily portable Cognitive-IADL (C-IADL) measure designed to assess an individual's executive functioning, the use of strategies and different components of online SA at a time (Toglia, 2015). Individuals are provided with a weekly calendar template and a list of 10 tasks or events to plan, such as appointments, meetings, or leisure activities. Rule constraints, challenges, and distractions are also incorporated to simulate the executive requirements to deal with the complexity and novelty of real-life activities. It provides information about the patient's ability to accurately enter appointments into a calendar while simultaneously examining the patient's frequency, type and effectiveness of strategies used (Toglia & White, 2020). Clinical observation of online SA takes place both during and immediately after task performance. This includes assessing the patient's ability to self-recognize errors, identify task challenges, and make realistic assessments of their performance through observation, semi-structured interview, and self-ratings and estimations of performance, which can then be compared with actual performance (Toglia, 2015). Research using the WCPA-10 in different clinical and non-clinical populations suggests that the test is effective in identifying deficits in executive functions and online SA. For example, Jaywant et al. (2022) found that individuals with stroke tended to overestimate their performance, exhibited lower self-recognition of errors, and were less likely to use self-monitoring strategies during the task compared to a healthy control group. Furthermore, overestimation was associated with worse overall performance. Similarly, Arora et al. (2021) found a gradual decline in WCPA-10 performance and lower effective strategy use across the adult lifespan. In their study, overestimation was associated with both poorer performance as well as with lower strategy use across all age groups. In particular, older adults with diminished SA used fewer strategies, self-recognized fewer errors, and presented worse overall performance in the WCPA. These findings align with those of a recent study by Marks et al. (2024), which used the more complex WCPA-17 and found a stronger correlation between accuracy and the number of strategies used by individuals in the aware group from a sample of community-dwelling adults. However, the authors did not include group as a variable in their analysis, leaving open the question of whether online SA moderates this relationship. Further research is needed to investigate this potential effect, particularly in individuals with ABI. Our previous research involved translating and adapting the WCPA-10 to the Spanish context (Salazar-Frías et al., 2023a), providing initial validation for its use among Spanish individuals with ABI. In line with a previous study by Jaywant et al. (2021) on the WCPA-10 and individuals with stroke, our findings reveal significantly poorer performance in accuracy, rules followed, and strategy use among individuals with ABI compared to healthy participants.

This study aimed to enhance the utility of the WCPA-10 as a functional cognitive assessment for Spanish individuals with ABI. First, we sought to expand on previous findings by examining performance differences on the Spanish WCPA-10 between individuals with ABI and a matched control group. Second, we assessed the instrument's ability to detect online SA deficits by comparing online SA measures across these groups. Following the work of Arora et al. (2021) and Jaywant et al. (2022), online SA was measured by the percentage of self-recognized errors and the use of self-monitoring strategies during the task. To measure online SA after the task, we generated two binary classifications – over-estimators vs. aware and over-raters vs. aware – based on discrepancies between actual and estimated accuracy and subjective self-ratings of performance compared to actual performance (see measures section for details). Our third objective was to explore the relationship between online SA measures and various sociodemographic, clinical, and cognitive variables within the ABI group to determine which measures may be more sensitive to these variables. Fourth, we aimed to explore potential differences in total strategy use and performance accuracy among healthy participants, ABI participants aware of their performance, and ABI participants who over-estimate their performance. Finally, we examined the potential moderating role of group (healthy participants, ABI aware, and ABI over-estimators) on the relationship between the number of strategies used and accuracy on the Spanish WCPA-10. We conducted a moderation analysis to test this hypothesis, expecting that the relationship would be stronger among individuals with ABI, particularly those aware of their performance.

METHODS

Participants

The study included a total of 156 participants, including 80 individuals with ABI and 76 healthy controls (HC), all of whom were native Spanish speakers. Individuals with ABI were recruited from cognitive/occupational rehabilitation services in four neuro-rehabilitation units in Granada and Malaga, Spain. The inclusion criteria were: (a) ABI diagnosis confirmed by neurological report at least 3 months prior to the study, with no specific restriction on the time since the onset of the ABI; (b) over 18 years of age; (c) presence of executive, metacognitive, and/or memory deficits as objectively assessed by the clinician; and (d) adequate arousal and behavioral control for the assessment. Exclusion criteria included: (a) severe motor or visual-perceptual deficits; (b) hemineglect; and (c) language impairments, such as reading and writing difficulties. Each rehabilitation center employed different measures to assess participant eligibility. For perceptual assessment, the team relied on clinical observation in daily activities and the Visual Object and Space Perception Battery (Warrington & James, 1991). To rule out attentional neglect, clinical observation during ADLs was used, supplemented by the line cancellation test from the Behavioral Inattention Test in uncertain cases (Sánchez-Cabeza et al., 2017). Language abilities were evaluated using the Boston Sentence Reading Test (Goodglass et al., 1986). HC individuals were adult volunteers recruited from the same geographical area as the individuals with ABI through snowball sampling by the researchers and their staff. The exclusion criteria for this group included global cognitive decline, as assessed by the the Mini-Mental State Examination and standardized neuropsychological tests (listed in table 1), or a reported history of neurological, psychiatric, or other medical conditions. Data from 53% of the sample (42 individuals with ABI and 42 HC) were taken from our previous study with the Spanish WCPA-10 (Salazar-Frías et al., 2023a). All individuals received a full explanation of the study before providing written informed consent. The study was approved by the Andalusian Ethics Committee for Biomedical Research (Anosognosia AVD2017, 3/01/2017, 0056-N-17). Table 1 summarizes the demographic and clinical characteristics of the sample.

Measures

The Spanish weekly calendar planning activity 10

The WCPA-10 is a C-IADL test of executive function, originally developed by Toglia (2015) and recently translated and validated in the Spanish context (Salazar-Frías et al., 2023a). It measures an individual's ability to perform a multistep activity, providing a comprehensive analysis of their ability to manage and cope with cognitively demanding tasks. Before starting the task, individuals are verbally instructed to schedule 10 appointments into a weekly calendar (some of which are fixed at a specific date/time, while others are flexible with multiple date/time options), following certain rules: keep track of time, ignore distracting questions, avoid scheduling on Wednesday, do not cross out appointments once entered, and inform the examiner when finished. During the task, the examiner carefully analysed the quality of the performance, including accuracy, the number and type of strategies used and self-monitoring skills. Common strategies include: (a) those that help keep track of information, such as verbal rehearsal, crossing off the designated day, or talking aloud about a strategy or plan; (b) those that assist in organizing information, such as entering fixed appointments before flexible ones, rearranging materials, using a written plan, or categorizing appointments; (c) those that enhance attention to key details, such as crossing off entered appointments, using a finger to direct attention, or highlighting key words; and (d) those that promote self-monitoring through self-checking or pausing to re-read (Arora et al., 2021). These strategies are documented on a checklist included in the instrument, with the examiner noting each strategy used by the participant (Toglia, 2015). After completing the task, individuals undergo an interview in which they rate their performance using a 4-point Likert scale (1 = "agree", 2 = "somewhat agree", 3 = "somewhat disagree", 4 = "disagree"), responding to statements about their performance, such as: "This task was easy for me", "I used efficient methods to complete this task", "I completed this task accurately", and "I kept track of everything I needed to do". They also estimate the number of correctly scheduled appointments and whether they were familiar with the task (i.e., whether they regularly used a weekly schedule). The task takes about 15 min to complete. The combination of quantitative scores, qualitative data, and responses to post-interview questions allows identifying several performance and online SA measures, which are described below.

Performance measures

Based on the original WCPA-10, the main performance outcomes used in this study are: (1) total strategies recorded by the examiner and reported by the individuals after completion of the task, strategy use was dichotomized (used vs. not used)

Table 1. Demographic and clinical data by group

	HC group n = 76	ABI group n = 80	Test[1] / Effect size
Age (years)			
Mean (SD)	46 (± 15)	55 (± 13)	$U = 2037^{**}$ / $r_{bis} = -0.33$
Range	18–75	24–76	
Education (years)			
Mean (SD)	12 (± 3)	11 (± 3)	$U = 3672^{*}$ / $r_{bis} = 0.21$
Range	8–17	8–17	
Gender (n, %)			
Female	31 (41%)	25 (31%)	$\chi^2(1) = 1.54$ / $\phi = 0.06$
Time since injury (months)			
Mean (SD)	-	16 (± 16)	-
Range	-	3–96	
Etiology (n, %)			
Stroke	-	63 (79%)	-
Tumor	-	7 (9%)	
Traumatic Brain Injury	-	6 (7%)	
Infection	-	4 (5%)	
Lesion location (n, %)			
Left Hemisphere	-	39 (49%)	-
Right Hemisphere	-	21 (26%)	
Bilateral	-	17 (20%)	
Cerebellar	-	4 (5%)	
Cognitive measures[2]			
INECO	26.6 (±1.4)	20.7 (±4.6)	$U = 201^{**}$ / $r_{bis} = 0.76$
Semantic Fluency	22.9 (±5.6)	15.5 (±5.1)	$U = 280^{**}$ / $r_{bis} = 0.67$
COWAT	43.5 (±13.1)	26.4 (±12.9)	$U = 295^{**}$ / $r_{bis} = 0.65$
RAVLT	51.3 (±8.6)	37.4 (±11.4)	$U = 311^{**}$ / $r_{bis} = 0.64$
Immediate recall			
Delayed recall	11.3 (±2.5)	7.1 (±4.2)	$U = 373^{**}$ / $r_{bis} = 0.57$
Executive composite	0.5 (0.5)	−0.6(0.7)	$U = 166^{**}$ / $r_{bis} = 0.81$
Memory composite	0.5(0.6)	−0.5(0.9)	$U = 308^{**}$ / $r_{bis} = 0.65$

Note: Significance levels: $* p < .05$, $** p < .01$; HC = Healthy Controls; ABI = Acquired Brain Injury; SD = Standard Deviation COWAT = Controlled Oral Word Association Test; RAVLT = Rey Auditory-Verbal Learning Test [1]Mann–Whitney U-test for continuous variables; Chi-square test for categorical variables. [2]Mean raw scores; these analyses were performed on a sample of n = 42 HC and n = 42 ABI, since not all individuals with an ABI could be assessed with the same cognitive tests.

without differentiating frequency; (2) number of rules followed out of 5; (3) number of accurately scheduled appointments out of 10; (4) planning time (time between starting the activity and entering the first appointment); and (5) total time to complete the task. Our previous study showed that the Spanish WCPA-10 has sufficient psychometric properties to be considered for detecting executive deficits that are likely to affect the quality of performance of everyday tasks in individuals with ABI and mild-to-severe cognitive deficits (Salazar-Frías et al., 2023a).

Online SA measures

Based on previous research, we assessed online SA by directly observing performance and probing during the post-task interview (Arora et al., 2021; Jaywant et al., 2022; Marks et al., 2024). During the task, the examiner recorded instances of self-recognized errors, including verbal or non-verbal acknowledgement of errors or attempts to correct them. The proportion of self-recognized errors to total errors served as the first online SA outcome. To reduce potential ceiling or floor effects, only individuals who made two or more errors were included in this analysis. Furthermore, individuals' use of self-monitoring strategies was assessed, specifically "self-checking" (i.e., double-checking appointments or reviewing their work spontaneously) and "pause and re-reading" (re-read instructions or review the list of appointments before proceeding). This categorization has been used in previous studies (Arora et al., 2021; Jaywant et al., 2022) and served as the second outcome for online SA. After the task, online SA was assessed using two methods. Firstly, the discrepancy between actual performance and estimated accuracy was computed. A discrepancy score of zero indicates agreement between the estimated and actual performance. A positive discrepancy score indicates that the individual's estimate exceeded their actual performance, whereas a negative score indicates the opposite. The sample was then divided into two groups: over-estimators and those aware of their performance based on the median estimation discrepancy of individuals with ABI, as described in Arora et al. (2021). Individuals with a negative discrepancy score were included in the "'aware" group, since underestimation implies that the individual recognized their errors (Arora et al., 2021; Jaywant et al., 2022). Secondly, we compared the subjective self-ratings of the performance to the actual performance. We calculated the average self-rating score for each individual, which was then used to categorize the individuals into two groups: those who rated the task as easy (average self-rating ≤ 2) and those who rated it as difficult (average self-rating > 2). We further divided the sample based on the patients' median accuracy score. Those who rated the task as easy but performed poorly (accuracy score < 4) were categorized as "over-raters", while individuals who rated the task as easy and performed well (accuracy score ≥ 4) or rated it as difficult and performed poorly (accuracy score < 4) were classified as "aware" of their performance. Individuals who rated the task as difficult and performed well (accuracy score ≥ 4) were included in the aware group (Arora et al., 2021). Categorization based on subjective self-ratings (aware vs. over-raters) was used for Aim 2. In contrast, categorization based on discrepancy score (aware vs. over-estimators) was used for Aims 4 and 5, as a previous study found it to be more sensitive in capturing awareness deficits (Marks et al., 2024).

Cognitive assessment

A standardized battery of cognitive tests was administered to assess memory and executive functions, as these domains play a critical role in functional limitations (Overdorp et al., 2016; Tiznado et al., 2021; Villalobos et al., 2020) and have a well-documented association with SA in individuals with ABI (Bivona et al., 2008; Ciurli et al., 2010; O'Keeffe et al., 2007b; Zimmermann et al., 2017). The Rey Auditory-Verbal Learning Test (RAVLT) was used to assess immediate memory (total words recalled across five learning trials) and delayed verbal memory (Schmidt, 1996). Executive functions were assessed using the INECO Frontal Screening (IFS; Torralva et al., 2009) and the Controlled Oral Word Association Test (Benton & Hamsher, 1989). The IFS is a brief cognitive screening test used to detect executive deficits in various neurological disorders (Bruno et al., 2015; Custodio et al., 2017; Pinasco et al., 2021). The maximum total score is 30 points; higher scores indicate better executive functions. For the Controlled Oral Word Association Test, individuals were given 60 s to produce as many words as possible that began with a given letter. Three trials were administered using the letters F, A, and S. In addition, a semantic verbal fluency task was included, in which individuals were given 60 s to provide as many animal names as possible. Composite scores for each cognitive domain were created by averaging the Z-scores of each test, serving as dependent variables in certain statistical analyses, as outlined in the next section. Composite scores were used in this study to minimize measurement error and reduce the risk of type I error associated with multiple comparisons (Clark et al., 2016).

Procedure

The research team developed a 4-hr training course with detailed instructions and examples to guide neuropsychologists and occupational therapists from collaborating neuro-rehabilitation units in administering the specified assessment tools. Follow-up practice sessions were held to provide feedback, clarify any questions regarding test administration and scoring. All assessments were conducted according to standardized protocols for each test by six experienced clinicians specializing in both rehabilitation and assessment of individuals with ABI. Importantly, the clinicians were blinded to the specific objectives and hypotheses of the study. Testing for individuals with ABI was conducted in quiet, office-like environments within each neuro-rehabilitation unit. For participants in the HC group, testing was conducted in similar settings at the Mind, Brain and Behaviour Research Centre (CIMCYC in Spanish) at the University of Granada and at the Faculty of Health Sciences of the University of Málaga. The tests were administered by researchers and two trained graduate students of occupational therapy, who received the same training as the clinicians.

Data analyses

All analyses were performed using R Studio (version 1.3.1093). The Shapiro–Wilk test indicated deviations from normal distribution for all variables of interest ($p < .01$ all), thus non-parametric tests were used. Group differences in demographic and clinical characteristics were assessed using the chi-square test for categorical variables, and Mann–Whitney U-test was applied for continuous variables. A non-parametric alternative to ANCOVA (Quade, 1967) and chi-square analyses were used to compare group differences in performance and online SA measures. The chi-square test examined the distribution of yes vs. no responses to the task familiarity question by group. Independent samples t-tests examined potential differences in total accuracy in the Spanish WCPA-10 based on familiarity within each group separately. Spearman's correlations determined the association between both online SA classifications and accuracy, as well as associations between the online SA measures and task familiarity, socio-demographic and clinical variables, and cognitive measures of executive function and memory in the ABI sample. Correlations were considered as low (<0.3), moderate (0.31–0.7), and strong (>0.71) (González et al., 2020). Furthermore, differences in total strategies used and total accuracy were compared by group (HC, aware and over-estimators) using Quade's test. Post-hoc analyses use Tukey-adjusted p-values to account for unequal group sizes (McHugh, 2011). Finally, we performed a regression analysis to examine the potential moderating role of group in the relationship between total strategies used and cognitive functional performance. The model included total accuracy in the Spanish WCPA-10 as the dependent variable, with total strategies used, group, and their interaction as predictors. The group variable was dummy-coded (0/1), thus aware individuals were the reference group. This analysis was performed using PROCESS version 4.3.1 for R, Model 1 (Hayes, 2022). The independent variable was mean-centered before the analysis. The bootstrapping method based on 5000 bootstrap samples was also used to estimate the confidence interval (CI) for the significance of the effects (Hayes & Rockwood, 2017). Simple slope analyses were then performed for each group to determine the relationships between total strategies used and total accuracy in the Spanish WCPA-10. Before conducting these analyses, standard regression diagnostic analyses were carried out using the performance R package (version 0.10.1; Lüdecke et al., 2021). Demographic variables, including age and years education, were controlled in all main analyses due to their well-documented influence on psychological testing outcomes, and specifically on the WCPA (Arora et al., 2021; Marks et al., 2024; Salazar-Frías et al., 2023a).

Table 2. Performance scores in the Spanish Weekly Calendar Planning Activity-10 by group

Performance Measures	HC group n = 76	ABI group n = 80	Test[1] / Effect size
Familiarity, n (%)			
Yes	29 (38%)	35 (44%)	χ^2 (1) = 0.60, ϕ = 0.00
No	47 (62%)	45 (56%)	
Total strategies used			
Mean (SD)	6.38 (± 1.9)	4.40 (± 2.4)	$F_{(1,154)} = 23.28^{**}$ / $\eta 2 = 0.13$
Median (IQR)	7 (5, 8)	4 (3, 6)	
Rules followed			
Mean (SD)	4.53 (± 0.6)	3.48 (± 1.2)	$F_{(1,154)} = 27.57^{**}$ / $\eta 2 = 0.15$
Median (IQR)	5 (0, 50)	4 (0, 12)	
Total accuracy			
Mean (SD)	8 (± 1.6)	4.06 (± 2.6)	$F_{(1,154)} = 91.51^{**}$ / $\eta 2 = 0.37$
Median (IQR)	8 (7, 9)	4 (2, 6)	
Planning time (sec)			
Mean (SD)	178 (± 288)	158 (± 317)	$F_{(1,154)} = 1.89$ / $\eta 2 = 0.01$
Median (IQR)	70 (35, 189)	60 (30, 116)	
Total time (sec)			
Mean (SD)	945 (± 434)	1089 (± 534)	$F_{(1,154)} = 0.78$ / $\eta 2 = 0.00$
Median (IQR)	846 (660, 1169)	923 (764, 1319)	

[1] Quade's distribution-free test (age and years of education as covariates) for continuous variables; Chi-square test for categorical variables. Note: Significance levels: * $p < .05$, ** $p < .01$

RESULTS

Demographic and clinical characteristics

Significant differences in age ($p < .01$) and years of education ($p < .05$) were observed between the HC and ABI groups, with the HC group having a higher proportion of younger adults and individuals with more years of education. There were no gender differences between groups. The primary diagnosis was stroke, with smaller percentages presenting etiologies, such as tumors, traumatic brain injury, and infections. There was also a higher prevalence of left hemisphere lesions with respect to right hemisphere, bilateral, and cerebellar lesions in the ABI sample (Table 1).

Differences between groups in the performance measures of the Spanish WCPA-10

The chi-squared test showed no significant differences in the proportion of yes vs. no responses to the task familiarity question. No significant differences in total accuracy were found between individuals who reported regular use of a schedule and those who did not, neither in the ABI group [$t_{(77)} = 1.86$, $p = .07$] nor in the HC group [$t_{(74)} = 0.14$, $p = .88$]. Table 2 shows differences between groups in the performance measures. Specifically, compared to the HC group, the ABI group scored significantly lower in total strategies ($p < .01$), rules followed ($p < .01$), and total accuracy ($p < .01$). No group differences were found for planning and total time scores.

Differences between groups in the online SA measures of the Spanish WCPA-10

During-task awareness

Table 3 summarizes the differences between groups in the online SA measures after controlling for age and years of education. The participants of the ABI group were less likely to use self-monitoring strategies compared to those of the HC group. Specifically, a significantly lower percentage of individuals in the ABI group (74%) used the pause-and-read strategy compared to the HC group (91%). Similarly, 60% of the ABI group used the self-checking strategy, compared to 87% of the HC group. Additionally, the participants of the ABI group were significantly less likely to recognize their errors than those of the HC group ($p < .05$).

After-task awareness

Estimation discrepancy differed significantly between groups ($p < .01$). Individuals in the ABI group overestimated their performance by a median of four appointments, compared to one appointment in the HC group (Table 3). When divided into over-estimators and aware, 41% of individuals with ABI were over-estimators compared to 3% of the HC group. Regarding subjective self-ratings, 31% of individuals with ABI were over-raters compared to 4% of the HC group. The correlation between both classifications was significant [$r^s{}_{(149)} = 0.48$, $p < .001$].

Correlation between online SA measures, socio-demographic, clinical and cognitive variables, and task familiarity in individuals with ABI

Table 4 summarizes the relationships between the online SA measures and various socio-demographic, clinical and cognitive variables in individuals with ABI. The use of self-monitoring strategies correlated positively and moderately with executive function. Similarly, a higher percentage of self-recognized errors was moderately associated with higher scores in executive function and memory. Finally, the estimation discrepancy scores showed a significant moderate negative correlation with executive function, indicating that greater discrepancies were associated with worse performance in tests of executive function.

Table 3. Online self-awareness scores in the Spanish Weekly Calendar Planning Activity-10 by group

Online awareness Measure	HC group n = 76	ABI group n = 80	Test[1], Effect size
During-task awareness			
Self-monitoring strategies, n (%)[2]			
Pause and read	69 (91%)	59 (74%)	χ^2 (1) = 7.68**, ϕ = 0.21
Self-checking	66 (87%)	48 (60%)	χ^2 (1) = 14.27**, ϕ = 0.29
Self-recognition of errors, %[3]			
Mean (SD)	23.55 (± 31.8)	8.79 (± 17.9)	$F_{(1,117)}$ = 4.78*, $\eta2$ = 0.04
Median (IRQ)	0 (0, 50)	0 (0, 13)	
After-task awareness			
Estimation discrepancy			
Mean (SD)	1.13 (± 1.7)	3.90 (± 2.6)	$F_{(1,154)}$ = 30.62**, $\eta2$ = 0.16
Median (IRQ)	1 (0, 2)	4 (2, 6)	
Awareness groups, n (%)			χ^2 (1) = 33.40**, ϕ = 0.46
Aware	74 (97%)	47 (59%)	
Over-estimators	2 (3%)	33 (41%)	
Self-rating, n (%)[4]			
Awareness groups, n (%)			χ^2 (1) = 17.65**, ϕ = 0.35
Aware	68 (96%)	54 (69%)	
Over-raters	3 (4%)	24 (31%)	

[1] Quade's distribution-free test (age and years of education as covariates) for continuous variables; Chi-square test for categorical variables. [2] Individuals that use every self-monitoring strategy. [3] Only individuals who made >2 errors were included in this analysis, HC (n = 42), ABI (n = 76). [4] This analysis was performed on a sample of 71 HC and 78 individuals with ABI due to missing values. Note: Significance levels: * $p < .05$, ** $p < .01$

Table 4. Spearman's correlations between the online SA measures, with socio-demographic, clinical and cognitive variables in the sample of individuals with acquired brain injury

Variables	Self-monitoring strategies	Self-recognized errors	Estimation discrepancy
Spanish WCPA-10			
Task familiarity	0.06	−0.11	−0.06
Socio-demographic			
Age	−0.13	−0.10	0.02
Years of education	0.17	0.04	−0.05
Clinical			
Time since injury	0.15	−0.04	0.00
Cognitive Composites[1]			
Executive function	**0.33***	**0.46****	**−0.34***
Memory	0.27	**0.35***	−0.04

[1] These analyses were performed on a small sample (n = 42), since not all individuals with an ABI could be assessed with the cognitive tests. Note: Bonferroni's adjusted significance levels: * $p < .05$, ** $p < .01$

Differences in total strategy use and performance accuracy on the Spanish WCPA-10 between healthy controls, individuals with ABI that are aware of their performance, and individuals with ABI who are over-estimators

Quade's ANCOVA compared the performance of the HC group, individuals with ABI that are aware of their performance and over-estimators on measures of total accuracy and total strategy use, while controlling for age and years of education. Significant between-group differences were found in total accuracy [$F_{(2,153)}$ = 60.61, $p < .01$, $\eta2$ = 0.44] and total strategy use [$F_{(2,153)}$ = 16.37, $p < .01$, $\eta2$ = 0.17]. Tukey's HSD test revealed that the HC group was significantly more accurate (M = 8.00, SD = 1.61) than the aware ABI group (M = 4.89, SD = 2.86, $p < .01$) and the ABI over-estimator group (M = 2.88, SD = 1.49, $p < .01$). Aware ABI individuals showed significantly higher accuracy than ABI over-estimators ($p < .01$). For total strategy use, Tukey's HSD test showed that the HC group used significantly more strategies (M = 6.38, SD = 1.93) than both aware ABI individuals (M = 4.87, SD = 2.32, $p < .01$) and ABI over-estimators (M = 3.73, SD = 2.30, $p < .01$). Aware ABI individuals used significantly more strategies than ABI over-estimators ($p = .04$). Figure 1 shows box and whisker plots of each measure by group.

Relationship between total strategies used and performance on the Spanish WCPA-10. Moderating effect of group: Healthy control, ABI aware individuals and ABI over-estimators

The assumptions of multicollinearity, homoscedasticity, normality of the residuals, and the examination of outliers were all met for this analysis. Table 5 displays the regression coefficients for the whole model. The dependent variable was total accuracy, with total strategies used as the predictor variable and dummy-coded group as the moderator variable. Age and years of education served as control variables. A statistically significant

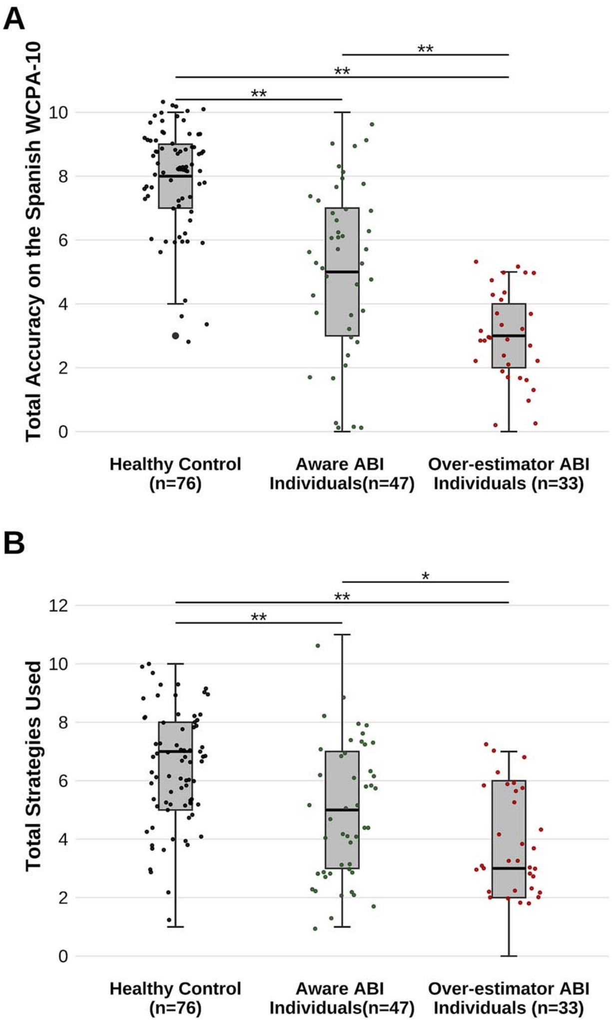

Fig. 1. Box and whisker plots of (A) total accuracy and (B) total strategies used on the Spanish WCPA-10 for the healthy controls, aware, and over-estimator groups. $* p < .05$; $** p < .01$.

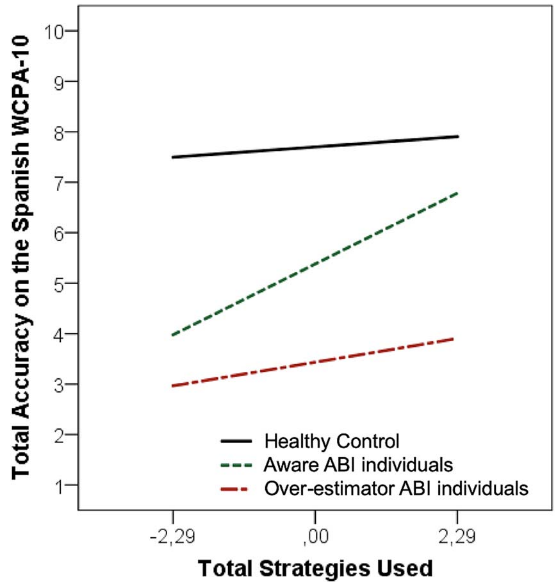

Fig. 2. Simple slopes of the total strategies used (mean-centered) over total accuracy on the Spanish WCPA-10 for each group.

interaction effect was found between total strategies used and dummy-coded group, with both HC ($p < .01$) and ABI over-estimators ($p < .05$) being significantly different from ABI aware individuals. As shown in Fig. 2, simple slope analyses for these interactions indicated that total strategies used were positively correlated with total accuracy for ABI aware individuals ($b = 0.61$, SE = 0.11, $p < .01$), suggesting that a larger number of strategies used was associated with better performance on the Spanish WCPA-10 (i.e., total accuracy). In contrast, total strategies used did not show a significant relationship with total accuracy for HC ($b = 0.09$, SE = 0.11, $p = .40$) or ABI over-estimator individuals ($b = 0.20$, SE = 0.16, $p = .22$).

DISCUSSION

Differences between groups in the performance measures of the Spanish WCPA-10

The first aim of this study was to extend our previous findings on performance measures using the Spanish WCPA-10 in individuals with ABI, by employing a larger sample size. In agreement with our previous research (Salazar-Frías et al., 2023a), the ABI group exhibited poorer overall performance compared to the HC group. Specifically, individuals with ABI demonstrated lower task accuracy, adhered to fewer rules, and employed fewer strategies. Moreover, in line with our previous findings, no significant differences were observed between the groups in terms of planning time and total time. Previous studies have also identified impairment in the performance measures of the WCPA, indicating that individuals with stroke (Jaywant et al., 2021) and other clinical populations (Doherty et al., 2022; Goverover et al., 2020; Zlotnik et al., 2020) experience more difficulties in everyday functioning compared to cognitively healthy individuals. These results highlight the Spanish WCPA-10 as a valuable tool for detecting executive difficulties that may affect real-world functioning in Spanish individuals with ABI.

Differences between groups in the online SA measures of the Spanish WCPA-10

More importantly, this study aimed to evaluate the instrument's effectiveness in identifying online SA deficits in Spanish individuals with ABI. Overall, we found significant differences in both during-task and after-task measures of online SA across the two groups. Specifically, our findings revealed a significantly lower percentage of individuals with ABI using self-monitoring strategies compared to HC. This aligns with findings from Jaywant et al. (2021), who reported that individuals with stroke were less likely to use self-checking strategies while completing the WCPA-10, compared to an age-matched HC group. To our knowledge, their study and ours are the only ones that have assessed the instrument's ability to detect online SA deficits in individuals with brain injury, based on US and Spanish samples, respectively.

Several ways of categorizing cognitive strategies have been proposed in the literature (Dole et al., 2009; Toglia & Foster, 2022; Weinstein et al., 2011), including self-monitoring strategies, such as self-checking (i.e., double-checking appointments

Table 5. Regression coefficients for moderating effects of group on the relationship between total strategies used and performance accuracy on the Spanish Weekly Calendar Planning Activity-10

Predictor variables	Spanish WCPA-10 total accuracy				
	Estimate	SE	*t*	Bootstrapping 95% CI[1]	
				LLCI	ULCI
(Intercept)	4.76**	0.90	5.27	3.14	6.42
Age	−0.02**	0.01	−2.80	−0.04	−0.01
Years of Education	0.17**	0.05	3.41	0.07	0.27
Total strategies used	0.61**	0.11	5.45	0.36	0.86
Dummy 1: Healthy Control[2]	2.31**	0.35	6.44	1.54	3.06
Dummy 2: Over-estimators[3]	−1.94**	0.48	−3.97	−2.78	−1.13
Total strategies used∗Dummy 1: Healthy Control	−0.52**	0.15	−3.39	−0.83	−0.21
Total strategies used∗Dummy 2: Over-estimators	−0.40*	0.20	−2.01	−0.75	−0.04
Model summary	$R^2 = 0.65, F_{(7,148)} = 39.66^{**}$				

[1]Based on $n = 5000$ bootstrap samples. [2]First dummy-coded group variable (0 = Aware, 1 = Healthy Control). [3]Second dummy-coded group variable (0 = Aware, 1 = Over-estimators). SE = standard error; LLCI = lower levels for confidence interval; ULCI = upper levels for confidence interval. Significance levels: ∗ $p < .05$, ∗∗ $p < .01$

or reviewing their work spontaneously) and pausing and re-reading (i.e., re-read instructions or review the list of appointments before proceeding). These types of strategies are defined as routines and procedures that allow individuals to monitor and evaluate their ongoing performance while accomplishing a task (Dole et al., 2009). These findings highlight the importance of examining the frequency and types of strategies used during task performance in individuals with ABI, as there is consistent evidence that they use strategies less frequently than healthy individuals (Burns et al., 2020; Jaywant et al., 2021). It also has important implications for identifying the most beneficial techniques for early cognitive rehabilitation after ABI, to successfully support the performance of complex everyday tasks (Schmitter-Edgecombe et al., 2021).

Our results also revealed significant group differences in the rate of self-recognized errors during task performance; specifically, individuals in the ABI group were less likely to recognize their own errors than those in the HC group. This ability is commonly observed in healthy adults and reflects the ability to monitor ongoing actions within the context of an activity (Arora et al., 2021; Toglia, 2015). Previous studies have also found that individuals with brain injury exhibited a diminished ability to self-correct their errors in both computer-based (McAvinue et al., 2005; O'Keeffe et al., 2007b) and structured naturalistic tasks (Doig et al., 2020; Hart et al., 1998). These findings are somewhat consistent with those of Jaywant et al. (2022). While their study also found that individuals with stroke were less likely to self-recognize errors than healthy controls, the difference they observed was not statistically significant. This may be due in part to their homogeneous sample, in terms of age, years of education, and time since injury. In contrast, our ABI sample was quite heterogeneous, including younger, and less educated individuals, as well as chronic individuals. Further research is needed to clarify the potential role of these variables in the online SA measures of the Spanish WCPA-10.

Regarding the after-task measures, our results indicate that individuals in the ABI group showed a greater discrepancy between their self-rating of performance and their actual performance compared to HC. They were also more likely to overestimate their accuracy, that is, their perceived accuracy was higher than their actual accuracy. This is supported by additional studies by Rotenberg-Shpigelman et al. (2014) and Barrett et al. (2014), who also found overestimation of performance in various ADLs among individuals with ABI. These findings have important implications for occupational safety, as individuals with ABI who overestimate their performance often fail to recognize their errors and use compensatory strategies, leading them to engage in activities beyond their capabilities (Rotenberg-Shpigelman et al., 2014; Sansonetti et al., 2024; Tyson et al., 2012). This finding is in line with the study by Jaywant et al. (2022), who also found overestimation in individuals with stroke. However, unlike Jaywant et al. (2022), we did not observe a tendency for the HC group to overestimate their performance on the WCPA-10. This difference might be due to the age disparity between our HC group including younger participants (mean = 46 years; SD = 15) and the older healthy individuals in Jaywant et al. (2022) (mean = 60 years; SD = 14). This is in line with previous findings showing that older adults tend to overestimate their performance more than younger adults on the WCPA-10 (Arora et al., 2021), and other IADL tasks (Huang et al., 2020; Sunderaraman et al., 2020). Future work is needed to develop normative data for different age groups for the Spanish WCPA-10.

Overall, these findings contribute to the growing body of research by enhancing the understanding of online SA in individuals with ABI, using an instrument specifically selected to measure C-IADL. This is important, as authors such as Sansonetti et al. (2024) and Toglia and Goverover (2022) have stressed the importance of carefully selecting methods to assess online SA in the context of familiar tasks, particularly through performance-based ADL tasks. Different tasks may be more sensitive for the measurement of specific aspects of online SA, such as self-evaluation or self-recognition of errors. For example, experimental tasks or neuropsychological tests may be less effective at measuring error detection, since errors in these tasks do not significantly affect task progression, thus individuals are less likely to detect them during performance, compared to highly familiar tasks such as ADL, where the errors are more obvious and have an impact on task progression (Sansonetti et al., 2024). This approach enables a more ecologically valid assessment, providing a comprehensive understanding of cognitive functioning, and specific aspects of online SA. Such information is essential to guide tailored rehabilitation strategies for the improvement of functional outcomes (Arora et al., 2021).

Correlation between online SA measures, socio-demographic, clinical and cognitive variables and task familiarity in individuals with ABI

This study also aimed to explore the relationship between online SA, cognitive, socio-demographic, and clinical variables, and task familiarity. In agreement with a previous study by Ricchetti et al. (2024a), who examined the association of online SA with cognitive variables in individuals with ABI in the context of everyday activities, the results from this study provide further evidence for the association of specific components of online SA with executive function. The positive correlations found between during-task measures of SA and executive function indicated that individuals with ABI who performed better on tests of executive function also made greater use of self-monitoring strategies and presented a greater proportion of self-recognized errors. This is consistent with most theoretical models of executive function that include processes such as monitoring and regulation as core executive components (Kennedy & Coelho, 2005; Miyake et al., 2000; Stuss & Alexander, 2000). As suggested by numerous authors (Fernandez-Duque et al., 2000; Roebers, 2017; Shimamura, 2000), executive functions are essential for goal-directed behavior, particularly in conflict situations that require individuals to adapt to changing environments, selectively process task-relevant information, and avoid irrelevant external stimuli. These components share a theoretical parallel, with specific components of online SA, such as self-monitoring and self-regulation (Toglia & Foster, 2022). Indeed, self-regulation has been recently shown to depend on a range of cognitive abilities, such as executive function and memory (Sansonetti et al., 2024; Toglia & Foster, 2022). Overall, these findings are particularly relevant, as most of the evidence supporting the association between online-SA deficits with deficient EF in individuals with ABI comes from studies using experimental tasks (Dockree et al., 2015b; McAvinue et al., 2005; F. O'Keeffe et al., 2007b), or by addressing the metacognitive component of SA (Bivona et al., 2008, 2019; Ciurli et al., 2010; Villalobos et al., 2021). To our knowledge, only the previous study by Ricchetti et al. (2024a) had examined this relationship in the context of a naturalistic task in individuals with ABI. These findings have significant implications for further understanding the relationship between online SA and executive function, as this type of task may provide stronger evidence for common cognitive processes involved in self-monitoring and self-regulation in everyday life. A note of caution is due here, as these analyses were not conducted with the full sample, since not all individuals were assessed with the cognitive tests.

Finally, it was found that the Spanish WCPA-10 online SA measures were not affected by task familiarity, age, years of education, or time since injury. While this is a desirable property of any cognitive test, it is somewhat surprising, as previous research has shown that age affects some online SA components in the WCPA (Arora et al., 2021). This finding may be partly explained by the fact that they measure online SA across a wide age range, from 18 to 92 years, which includes periods of old age. To our knowledge, the relationship between the online SA measures of the WCPA and these socio-demographic and clinical variables has not been investigated in a sample of individuals with ABI. Further research is needed to explore the relationship of these variables with online SA.

Differences in total strategy use and performance accuracy on the Spanish WCPA-10 between healthy controls, individuals with ABI that are aware of their performance, and individuals with ABI who are over-estimators

We also explored how strategy use and accuracy on the Spanish WCPA-10 differs among individuals with ABI who are aware of their performance, those who overestimate it, and HC. Our findings show that individuals with ABI who were aware of their performance used more strategies and had better accuracy than those who overestimated it. The HC group had higher strategy use and accuracy than both groups of ABI individuals. These results corroborate the ideas of Toglia and White (2020) who suggested that effective strategy use is a central aspect of healthy functional performance. They are also consistent with other literature reporting that individuals with ABI often experience cognitive deficits that affect their ability to perform everyday tasks and to use cognitive strategies to improve it (Nott & Chapparo, 2020). This is further supported by additional studies that have reported lower or inefficient strategy use and poorer functional performance in individuals with ABI (Bottari et al., 2014; Burns et al., 2020; Nott & Chapparo, 2020) and in a variety of clinical populations (Brum et al., 2013; Johnson et al., 2005; Kaizerman-Dinerman et al., 2019; Schmitter-Edgecombe et al., 2014).

Relationship between total strategies used and performance on the Spanish WCPA-10. Moderating effect of group: Healthy control, ABI aware individuals and ABI over-estimators

Taking advantage of the WCPA's ability to simultaneously measure strategy use and online SA in the context of a functional task, we aimed to investigate whether online SA moderates the relationship between total strategies used and performance accuracy on the Spanish WCPA-10. To our knowledge, this is the first study to systematically examine strategy use in relation to performance on the WCPA-10 in individuals with ABI, both with and without online SA deficits, and in HC. Results from the moderator analysis revealed stronger positive associations between strategy use and accuracy in individuals with ABI who were aware of their performance compared to over-estimators and HC. Specifically, a greater number of strategies used was associated with better accuracy in the group of individuals with ABI who were aware of their performance, whereas this association was not significant in the over-estimators or the HC group.

These findings support the idea that individuals with ABI who have low levels of online SA may have inaccurate self-evaluations of their performance, due to undetected errors or task difficulties (Jaywant et al., 2022; Sansonetti et al., 2024). This lack of accurate self-evaluation can lead them to perceive a reduced need to use strategies, or to use them ineffectively, thereby hindering their ability to manage and adapt to cognitively demanding tasks. Conversely, individuals with enhanced online SA are more likely to accurately understand the demands and challenges of a task (Toglia & Foster, 2022). This might enable them to recognize the importance of using strategies or seeking assistance when necessary. As a result, these individuals may be more likely to employ appropriate and efficient strategies to enhance their performance. This approach to task management contributes to greater functional independence, as they can better navigate and adapt to the challenges they encounter in daily life.

Toglia and White (2020) suggested that the ability to accurately self-evaluate and utilize strategies effectively is a critical component of successful rehabilitation and independent performance. Our study found that individuals in the HC group, who typically performed optimally on cognitive tests, completed the task accurately regardless of the number of strategies they used. Toglia and Foster (2022) noted that strategies yield the best results when activities present an optimal level of challenge. This is particularly relevant, as we used the most simple 10-item version of the WCPA, which is designed for inpatient settings where patients may have lower levels of functioning or time constraints (Toglia, 2015). This may explain the lack of association between the number of strategies used and performance on the Spanish WCPA-10 in HC individuals, with many individuals performing adequately on the task regardless of the number of strategies used. Further moderation studies using more complex versions of the WCPA are needed to explore the relationship between the number of strategies used, performance, and online SA in HC individuals. In contrast, individuals with ABI who were aware of their performance and used more strategies achieved performance levels comparable to those without brain injury. However, over-estimators who inaccurately assessed their abilities tended to use fewer strategies and when they used them they did it inefficiently, resulting in poorer task performance. These results suggest that, while strategies can serve as cognitive compensation tools for individuals with cognitive deficits, their effective use requires a certain level of online SA. A prior study by Schmitter-Edgecombe et al. (2014) also noted the importance of strategies and awareness for successful independent performance in a sample of normal ageing adults and individuals with mild cognitive impairment and dementia. They found a higher self- and informant-reported use of strategies in individuals with mild cognitive impairment, in response to perceived cognitive decline, compared to more cognitively impaired individuals with dementia, who exhibited a lack of insight of their deficits. In addition to the differences in clinical samples, a key distinction between the latter study and ours is that we used a performance-based C-IADL task to more directly measure awareness and strategy use, rather than self- and informant-based questionnaires. To reduce the potential misinterpretation of an individual's abilities inherent in these questionnaires (Arora et al., 2021; Schmitter-Edgecombe et al., 2014), future research should rely on direct observation during performance-based tasks, such as the WCPA-10. These tasks allow for a more comprehensive assessment, including the number and types of strategies used, the ability to self-recognize errors, and a more realistic self-evaluation of the individual's performance through observation, semi-structured interviews, and self-reports (Toglia & White, 2020). Overall, these findings shed light on the learning potential of individuals with ABI and support the effective implementation of interventions that prioritize the enhancement of strategy use and online SA, through metacognitive approaches to improve cognitive functional performance and promote greater independence, as systematically recommended by various recent studies and reviews (Cicerone et al., 2019; Jeffay et al., 2023; Salazar-Frías et al., 2024; Swanton et al., 2020; Toglia & Foster, 2022). Furthermore, these results underscore the need for further research on the mechanisms underlying online SA and strategy use, as well as the development of targeted interventions to support individuals with ABI in their recovery.

LIMITATIONS

The current study has a number of limitations. Firstly, our analysis focused primarily on the total number of strategies used. A large body of literature suggest that strategies should be examined beyond their total number and include different types, depending on the level of mental effort invested in their implementation (Dole et al., 2009; Toglia & Foster, 2022; Weinstein et al., 2011). To better understand the underlying factors that influence strategy use and to develop more tailored rehabilitation approaches, future studies should explore the different types of strategies, their effectiveness, and the effort required for their implementation. Also, further studies are needed to explore how the number of errors made during the Spanish WCPA-10 influences the proportion of those errors that are detected, as both factors may serve as important markers of overall cognitive or functional severity. Secondly, we only considered the online component of SA. Further research should investigate how metacognitive knowledge relates to strategy use to gain a better understanding of its impact on functional independence. We acknowledge that our sample presented significant heterogeneity in both etiology and lesion location, with some etiologies, such as stroke, being far more prevalent than others. By analyzing these diverse cases as a single group, we were unable to explore whether specific patterns of deficits on the online SA measures of the Spanish WCPA-10 might emerge based on different etiologies or lesion sites. We recognize this as an important issue that warrants further investigation in future research. We also recognize the various limitations of using composite scores, including but not limited to the fact that it provides broader measures of cognitive functions. A more comprehensive and differentiated assessment of executive functions, as well as other cognitive processes such as memory and attention will be essential in future studies to further clarify their association with online SA in individuals with ABI. Finally, additional psychometric data, including test–retest and inter-rater reliability studies, are needed to confirm the temporal stability of the Spanish WCPA-10 outcomes and to ensure that subjective judgments do not influence the results.

FUNDING

This work was supported by the Spanish Ministry of Economy and Competitiveness research project PSI2016–80331-P awarded to MJF. DS-F is supported by the National Council of Science and Technology scholarship (CVU- 349933).

ACKNOWLEDGEMENTS

The authors would like to thank the collaboration of the participants, their caregivers, the occupational therapists and the neuropsychologists of the four healthcare centers for their help in collecting the data. Funding for open access charge: Universidad de Granada / CBUA

AUTHOR CONTRIBUTIONS

Daniel Salazar-Frías (Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing—original draft, Writing—review & editing), M. J. Funes (Conceptualization, Methodology, Supervision, Visualization, Writing—review & editing), Ana Clara Szot (Investigation, Methodology), Lucía Laffarga (Investigation, Methodology), Alba Navarro-Egido (Investigation, Methodology), and María Rodríguez-Bailón (Conceptualization, Methodology, Supervision, Visualization, Writing—review & editing)

REFERENCES

Aronov, A., Rabin, L. A., Fogel, J., Chi, S. Y., Kann, S. J., Abdelhak, N., et al. (2015). Relationship of cognitive strategy use to prospective memory performance in a diverse sample of nondemented older adults with varying degrees of cognitive complaints and impairment. *Neuropsychology, Development, and Cognition. Section B, Aging, Neuropsychology and Cognition*, 22(4), 486–501. https://doi.org/10.1080/13825585.2014.984653.

Arora, C., Frantz, C., & Toglia, J. (2021). Awareness of performance on a functional cognitive performance-based assessment across the adult lifespan. *Frontiers in Psychology*, 12, 5195. https://doi.org/10.3389/fpsyg.2021.753016.

Barrett, A. M., Galletta, E. E., Zhang, J., Masmela, J. R., & Adler, U. S. (2014). Stroke survivors over-estimate their medication self-administration (MSA) ability, predicting memory loss. *Brain Injury*, 28(10), 1328–1333. https://doi.org/10.3109/02699052.2014.915984.

Benton, A. I., & Hamsher, K. (1989). *Multilingual aphasia examination*. IA: AJA Associates.

Bettcher, B. M., Giovannetti, T., Libon, D. J., Eppig, J., Wambach, D., & Klobusicky, E. (2011). Improving everyday error detection, one picture at a time: A performance-based study of everyday task training. *Neuropsychology*, 25(6), 771–783. https://doi.org/10.1037/a0024107.

Bettcher, B. M., Giovennetti, T., MacMullen, L., & Libon, D. J. (2008). Error detection and correction patterns in dementia: A breakdown of error monitoring processes and their neuropsychological correlates. *Journal of the International Neuropsychological Society*, 14(02), 199–208. https://doi.org/10.1017/S1355617708080193.

Bivona, U., Ciurli, P., Barba, C., Onder, G., Azicnuda, E., Silvestro, D., et al. (2008). Executive function and metacognitive self-awareness after severe traumatic brain injury. *Journal of the International Neuropsychological Society*, 14(5), 862–868. https://doi.org/10.1017/S1355617708081125.

Bivona, U., Ciurli, P., Ferri, G., Fontanelli, T., Lucatello, S., Donvito, T., et al. (2020). The self-awareness multilevel assessment scale, a new tool for the assessment of self-awareness after severe acquired brain injury: Preliminary findings. *Frontiers in Psychology*, 11, 1732. https://doi.org/10.3389/fpsyg.2020.01732.

Bivona, U., Costa, A., Contrada, M., Silvestro, D., Azicnuda, E., Aloisi, M., et al. (2019). Depression, apathy and impaired self-awareness following severe traumatic brain injury: A preliminary investigation. *Brain Injury*, 33(9), 1245–1256. https://doi.org/10.1080/02699052.2019.1641225.

Bottari, C., Wai Shun, P. L., Le Dorze, G., Gosselin, N., & Dawson, D. (2014). Self-generated strategic behavior in an ecological shopping task. *American Journal of Occupational Therapy*, 68(1), 67–76. https://doi.org/10.5014/ajot.2014.008987.

Brum, P. S., Yassuda, M. S., & Forlenza, O. V. (2013). Subjective memory and strategy use in mild cognitive impairment and healthy aging. *Psychology & Neuroscience*, 6(1), 89–94. https://doi.org/10.3922/j.psns.2013.1.13.

Bruno, D., Torralva, T., Marenco, V., Ardilla, J. T., Baez, S., Gleichgerrcht, E., et al. (2015). Utility of the INECO frontal screening (IFS) in the detection of executive dysfunction in patients with relapsing-remitting multiple sclerosis (RRMS). *Neurological Sciences : Official Journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology*, 36(11), 2035–2041. https://doi.org/10.1007/S10072-015-2299-6.

Burns, S. P., Dawson, D. R., Perea, J. D., Vas, A. K., Pickens, N. D., Marquez de la Plata, C., et al. (2020). Associations between self-generated strategy use and MET-home performance in adults with stroke. *Neuropsychological Rehabilitation*, 30(8), 1543–1557. https://doi.org/10.1080/09602011.2019.1601112.

Chen, M. H., & Goverover, Y. (2021). Self-awareness in multiple sclerosis: Relationships with executive functions and affect. *European Journal of Neurology*, 28(5), 1627–1635. https://doi.org/10.1111/ene.14762.

Chen, P., & Toglia, J. (2019). Online and offline awareness deficits: Anosognosia for spatial neglect. *Rehabilitation Psychology*, 64(1), 50–64. https://doi.org/10.1037/REP0000207.

Chudoba, L. A., & Schmitter-Edgecombe, M. (2020). Insight into memory and functional abilities in individuals with amnestic mild cognitive impairment. *Journal of Clinical and Experimental Neuropsychology*, 42(8), 822–833. https://doi.org/10.1080/13803395.2020.1817338.

Cicerone, K. D., Goldin, Y., Ganci, K., Rosenbaum, A., Wethe, J. V., Langenbahn, D. M., et al. (2019). Evidence-based cognitive rehabilitation: Systematic review of the literature from 2009 through 2014. *Archives of Physical Medicine and Rehabilitation*, 100(8), 1515–1533. https://doi.org/10.1016/j.apmr.2019.02.011.

Ciurli, P., Bivona, U., Barba, C., Onder, G., Silvestro, D., Azicnuda, E., et al. (2010). Metacognitive unawareness correlates with executive function impairment after severe traumatic brain injury. *Journal of the International Neuropsychological Society*, 16(2), 360–368. https://doi.org/10.1017/S135561770999141X.

Clark, L. R., Racine, A. M., Koscik, R. L., Okonkwo, O. C., Engelman, C. D., Carlsson, C. M., et al. (2016). Beta-amyloid and cognitive decline in late middle age: Findings from the Wisconsin registry for Alzheimer's prevention study. *Alzheimer's & Dementia : The Journal of the Alzheimer's Association*, 12(7), 805–814. https://doi.org/10.1016/j.jalz.2015.12.009.

Custodio, N., Montesinos, R., Lira, D., Herrera-Perez, E., Bardales, Y., & Valeriano-Lorenzo, L. (2017). Evolution of short cognitive test performance in stroke patients with vascular cognitive impairment and vascular dementia: Baseline evaluation and follow-up. *Dementia & Neuropsychologia*, 11(4), 381–388. https://doi.org/10.1590/1980-57642016dn11-040007.

Dockree, P. M., O'Connell, R. G., & Robertson, I. H. (2015a). Connecting clinical and experimental investigations of awareness in traumatic brain injury. *Handbook of Clinical Neurology*, 128, 511–524. https://doi.org/10.1016/B978-0-444-63521-1.00032-7.

Dockree, P. M., Tarleton, Y. M., Carton, S., & FitzGerald, M. C. C. (2015b). Connecting self-awareness and error-awareness in patients with traumatic brain injury. *Journal of the International Neuropsychological Society*, 21(7), 473–482. https://doi.org/10.1017/S1355617715000594.

Doherty, M., Dickerson, D., Kadela, K., Noetzel, M., Wolf, T. J., Berg, C., et al. (2022). *Initial validation of the weekly calendar planning activity with adolescents with ABI*. OTJR: Occupation, Participation and Health. https://doi.org/10.1177/15394492221087191

Doig, E., Fleming, J., & Lin, B. (2017). Comparison of online awareness and error behaviour during occupational performance by two individuals with traumatic brain injury and matched controls. *NeuroRehabilitation*, 40(4), 519–529. https://doi.org/10.3233/NRE-171439.

Doig, E. J., Fleming, J., & Ownsworth, T. (2020). Evaluation of an occupation-based metacognitive intervention targeting awareness, executive function and goal-related outcomes after traumatic brain injury using single-case experimental design methodology. *Neuropsychological Rehabilitation*, 31(10), 1527–1556. https://doi.org/10.1080/09602011.2020.1786410.

Dole, J. A., Nokes, J. D., & Drits, D. (2009). Cognitive strategy instruction. In Duffy, G. G., & Israel, S. E. (Eds.), *Handbook of research on reading comprehension* (pp. 347–372). New York, NY: Routledge.

van Erp, S., & Steultjens, E. (2020). Impaired awareness of deficits and cognitive strategy use in occupational performance of persons with acquired brain injury (ABI). *Irish Journal of Occupational Therapy*, 48(2), 101–115. https://doi.org/10.1108/IJOT-10-2019-0012.

Farias, S. T., Gravano, J., Weakley, A., Schmitter-Edgecombe, M., Harvey, D., Mungas, D., et al. (2020). The everyday compensation (EComp) questionnaire: Construct validity and associations with diagnosis and longitudinal change in cognition and everyday function in older adults. *Journal of the International Neuropsychological Society*, 26(3), 303–313. https://doi.org/10.1017/S135561771900119X.

Fernandez-Duque, D., Baird, J. A., & Posner, M. I. (2000). Executive attention and metacognitive regulation. *Consciousness and Cognition*, 9(2), 288–307. https://doi.org/10.1006/ccog.2000.0447.

Fleming, J., Strong, J., & Ashton, R. (1996). Self-awareness of deficits in adults with traumatic brain injury: How best to measure? *Brain Injury*, 10(1), 1–15. https://doi.org/10.1080/026990596124674.

Geary, E. K., Kraus, M. F., Rubin, L. H., Pliskin, N. H., & Little, D. M. (2011). Verbal learning strategy following mild traumatic brain injury. *Journal of the International Neuropsychological Society : JINS*, 17(4), 709–719. https://doi.org/10.1017/S1355617711000646.

Giovannetti, T., Libon, D. J., & Hart, T. (2002). Awareness of naturalistic action errors in dementia. *Journal of the International Neuropsychological Society*, 8(5), 633–644. https://doi.org/10.1017/S135561770280131X.

González, M. Á. M., Villegas, A. S., Atucha, E. T., & Fajardo, J. F. (2020). *Bioestadística amigable* (2nd ed.). España: Elsevier.

Goodglass, H., Kaplan, E., García Albea, J. E., & Sánchez Bernardos, M. L. (1986). *Evaluación de la afasia y de trastornos relacionados*. España: Editorial Médica Panamericana.

Goverover, Y., Johnston, M. V., Toglia, J., & DeLuca, J. (2007). Treatment to improve self-awareness in persons with acquired brain injury. *Brain Injury*, 21(9), 913–923. https://doi.org/10.1080/02699050701553205.

Goverover, Y., Toglia, J., & DeLuca, J. (2020). The weekly calendar planning activity in multiple sclerosis: A top-down assessment of executive functions. *Neuropsychological Rehabilitation*, 30(7), 1372–1387. https://doi.org/10.1080/09602011.2019.1584573.

Hart, T., Giovannetti, T., Montgomery, M. W., & Schwartz, M. F. (1998). Awareness of errors in naturalistic action after traumatic brain injury. *Journal of Head Trauma Rehabilitation*, 13(5), 16–28. https://doi.org/10.1097/00001199-199810000-00004.

Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach (third edition)*. New York, NY: Guilford publications.

Hayes, A. F., & Rockwood, N. J. (2017). Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation. *Behaviour Research and Therapy*, 98, 39–57. https://doi.org/10.1016/j.brat.2016.11.001.

Hoerold, D., Pender, N. P., & Robertson, I. H. (2013). Metacognitive and online error awareness deficits after prefrontal cortex lesions. *Neuropsychologia*, 51(3), 385–391. https://doi.org/10.1016/j.neuropsychologia.2012.11.019.

Huang, G., Luster, M., Karagol, I., Park, J. W., & Pitts, B. J. (2020). Self-perception of driving abilities in older age: A systematic review. *Transportation Research Part F: Traffic Psychology and Behaviour*, 74, 307–321. https://doi.org/10.1016/j.trf.2020.08.020.

Jaywant, A., Arora, C., Lussier, A., & Toglia, J. (2021). Impaired performance on a cognitively-based instrumental activities of daily living task, the 10-item weekly calendar planning activity, in individuals with stroke undergoing acute inpatient rehabilitation. *Frontiers in Neurology*, 12, 704775. https://doi.org/10.3389/fneur.2021.704775.

Jaywant, A., Arora, C., & Toglia, J. (2022). Online awareness of performance on a functional cognitive assessment in individuals with stroke: A case-control study. *Neuropsychological Rehabilitation.*, 32(8), 1970–1988. https://doi.org/10.1080/09602011.2022.2050409.

Jeffay, E., Ponsford, J., Harnett, A., Janzen, S., Patsakos, E., Douglas, J., et al. (2023). INCOG 2.0 guidelines for cognitive rehabilitation following traumatic brain injury, part III: Executive functions. *The Journal of Head Trauma Rehabilitation*, 38(1), 52–64. https://doi.org/10.1097/HTR.0000000000000834.

Johnson, A. M., Pollard, C. C., Vernon, P. A., Tomes, J. L., & Jog, M. S. (2005). Memory perception and strategy use in Parkinson's disease. *Parkinsonism & Related Disorders*, 11(2), 111–115. https://doi.org/10.1016/j.parkreldis.2004.06.005.

Kaizerman-Dinerman, A., Josman, N., & Roe, D. (2019). The use of cognitive strategies among people with schizophrenia: A randomized comparative study. *The Open Journal of Occupational Therapy*, 7(3), 1–12. https://doi.org/10.15453/2168-6408.1621.

Kennedy, M. R. T., & Coelho, C. (2005). Self-regulation after traumatic brain injury: A framework for intervention of memory and problem solving. *Seminars in Speech and Language*, 26(04), 242–255. https://doi.org/10.1055/s-2005-922103.

Lüdecke, D., Ben-Shachar, M. S., Patil, I., Waggoner, P., & Makowski, D. (2021). Performance: An R package for assessment, comparison and testing of statistical models. *Journal of Open Source Software*, 6(60), 3139. https://doi.org/10.21105/joss.03139.

Mahoney, D., Grajo, L., & Gillen, G. (2021). Content validity of the OT anticipatory awareness test: A functional cognitive assessment for adults with neurological conditions. *American Journal of Occupational Therapy*, 75(Supplement_2), 7512500060p1. https://doi.org/10.5014/ajot.2021.75S2-RP60.

Marks, T. S., Giles, G. M., & Edwards, D. F. (2024). Online awareness is associated with superior performance on assessments of functional cognition. *Frontiers in Aging Neuroscience*, 16, 1384812. https://doi.org/10.3389/fnagi.2024.1384812.

McAvinue, L., O'Keeffe, F., McMackin, D., & Robertson, I. H. (2005). Impaired sustained attention and error awareness in traumatic brain injury: Implications for insight. *Neuropsychological Rehabilitation*, 15(5), 569–587. https://doi.org/10.1080/09602010443000119.

McHugh, M. L. (2011). Multiple comparison analysis testing in ANOVA. *Biochemia Medica*, 21(3), 203–209. https://doi.org/10.11613/bm.2011.029.

Merchán-Baeza, J. A., Rodriguez-Bailon, M., Ricchetti, G., Navarro-Egido, A., & Funes, M. J. (2020). Awareness of cognitive abilities in the execution of activities of daily living after acquired brain injury: An evaluation protocol. *BMJ Open*, 10(10), e037542. https://doi.org/10.1136/BMJOPEN-2020-037542.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The Unity and Diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100. https://doi.org/10.1006/cogp.1999.0734.

Morris, R. G., Nelis, S. M., Martyr, A., Markova, I., Roth, I., Woods, R. T., et al. (2016). Awareness of memory task impairment versus everyday memory difficulties in dementia. *Journal of Neuropsychology*, 10(1), 130–142. https://doi.org/10.1111/jnp.12062.

Nagelkop, N. D., Rosselló, M., Aranguren, I., Lado, V., Ron, M., & Toglia, J. (2021). Using multicontext approach to improve instrumental activities of daily living performance after a stroke: A case report. *Occupational Therapy in Health Care*, 35(3), 249–267. https://doi.org/10.1080/07380577.2021.1919954.

Nott, M. T., & Chapparo, C. (2020). Cognitive strategy use in adults with acquired brain injury. *Brain Injury*, 34(4), 508–514. https://doi.org/10.1080/02699052.2020.1725837.

O'Keeffe, F., Dockree, P., Moloney, P., Carton, S., & Robertson, I. H. (2007a). Awareness of deficits in traumatic brain injury: A multidimensional approach to assessing metacognitive knowledge and online-awareness. *Journal of the International Neuropsychological Society*, 13(01), 38–49. https://doi.org/10.1017/S1355617707070075.

O'Keeffe, F. M., Murray, B., Coen, R. F., Dockree, P. M., Bellgrove, M. A., Garavan, H., et al. (2007b). Loss of insight in frontotemporal dementia, corticobasal degeneration and progressive supranuclear palsy. *Brain*, 130(3), 753–764. https://doi.org/10.1093/brain/awl367.

Overdorp, E. J., Kessels, R. P. C., Claassen, J. A., & Oosterman, J. M. (2016). The combined effect of neuropsychological and neuropathological deficits on instrumental activities of daily living in older adults: A systematic review. *Neuropsychology Review*, 26(1), 92–106. https://doi.org/10.1007/s11065-015-9312-y.

Ownsworth, T., Fleming, J., Desbois, J., Strong, J., & Kuipers, P. (2006). A metacognitive contextual intervention to enhance error awareness and functional outcome following traumatic brain injury: A single-case experimental design. *Journal of the International Neuropsychological Society*, 12(1), 54–63. https://doi.org/10.1017/S135561770606005X.

Ownsworth, T., Quinn, H., Fleming, J., Kendall, M., & Shum, D. (2010). Error self-regulation following traumatic brain injury: A single case study evaluation of metacognitive skills training and behavioural practice interventions. *Neuropsychological Rehabilitation*, 20(1), 59–80. https://doi.org/10.1080/09602010902949223.

Pinasco, C., Oviedo, M., Goldfeder, M., Bruno, D., Lischinsky, A., Torralva, T., et al. (2021). Sensitivity and specificity of the INECO frontal screening (IFS) in the detection of patients with traumatic brain injury presenting executive deficits. *Applied Neuropsychology:Adult*, 30(3), 289–296. https://doi.org/10.1080/23279095.2021.1937170.

Prigatano, G. P. (2005). Disturbances of self-awareness and rehabilitation of patients with traumatic brain injury: A 20-year perspective. *The Journal of Head Trauma Rehabilitation*, 20(1), 19–29. https://doi.org/10.1097/00001199-200501000-00004.

Prigatano, G. P., Fordyce, D. J., Zeiner, H. K., Roueche, J. R., Pepping, M., & Wood, B. C. (1986). *Neuropsychological rehabilitation after brain injury*. Baltimore: Johns Hopkins University Press.

Quade, D. (1967). Rank analysis of covariance. *Journal of the American Statistical Association*, 62(320), 1187–1200. https://doi.org/10.1080/01621459.1967.10500925.

Ricchetti, G., Navarro-Egido, A., Rodríguez-Bailón, M., Salazar-Frías, D., Merchán-Baeza, J. A., Ariza-Vega, P., et al. (2024a). The breakfast and dressing conflict task: Preliminary evidence of its validity to measure online self-awareness after acquired brain injury. *American Journal of Occupational Therapy*, 78(2), 7802180020. https://doi.org/10.5014/ajot.2024.050346.

Ricchetti, G., Navarro-Egido, A., Rodríguez-Bailón, M., Salazar-Frías, D., Narganes-Pineda, C., & Funes, M. J. (2024b). Identifying conflict monitoring as a specific executive component that contributes to impaired self-awareness in patients with acquired brain injury. *Journal of Clinical and Experimental Neuropsychology*, 46(7), 655–668. https://doi.org/10.1080/13803395.2024.2391363.

Robertson, K., & Schmitter-Edgecombe, M. (2015). Self-awareness and traumatic brain injury outcome. *Brain Injury*, 29(7–8), 848–858. https://doi.org/10.3109/02699052.2015.1005135.

Roebers, C. M. (2017). Executive function and metacognition: Towards a unifying framework of cognitive self-regulation. *Developmental Review*, 45, 31–51. https://doi.org/10.1016/j.dr.2017.04.001.

Rotenberg-Shpigelman, S., Rosen-Shilo, L., & Maeir, A. (2014). Online awareness of functional tasks following ABI: The effect of task experience and associations with underlying mechanisms. *NeuroRehabilitation*, 35(1), 47–56. https://doi.org/10.3233/NRE-141101.

Salazar-Frías, D., Funes, M. J., Merchán-Baeza, J. A., Ricchetti, G., Torralba-Muñoz, J. M., & Rodríguez-Bailón, M. (2023a). Translation, cross-cultural adaptation and validation of the 10-item weekly calendar planning activity in Spanish-speaking ABI patients: A multicenter study. *Frontiers in Psychology*, 14, 1–17. https://doi.org/10.3389/fpsyg.2023.1018055.

Salazar-Frías, D., Rodriguez-Bailon, M., Ricchetti, G., Navarro-Egido, A., de los Santos, M., & Funes, M. J. (2024). Training to deal with distractions and conflicting situations in activities of daily living after traumatic brain injury (TBI): Preliminary evidence from a single-case experimental design study. *Neuropsychological Rehabilitation*, 1–36, 1–36. https://doi.org/10.1080/09602011.2024.2375495.

Salazar-Frías, D., Rodríguez-Bailón, M., Ricchetti, G., Navarro-Egido, A., & Funes, M. J. (2023b). The cognitive awareness scale for basic and instrumental activities of daily living to measure self-awareness after acquired brain injury: Preliminary evidence of its validity. *The Clinical Neuropsychologist*, 38(5), 1133–1155. https://doi.org/10.1080/13854046.2023.2278822.

Sánchez-Cabeza, Á., Huertas-Hoyas, E., Máximo-Bocanegra, N., Martínez-Piédrola, R. M., Pérez-de-Heredia-Torres, M., & Alegre-Ayala, J. (2017). Spanish transcultural adaptation and validity of the Behavioral inattention test. *Occupational Therapy International*, 2017, 1423647–1423647, 7. https://doi.org/10.1155/2017/1423647.

Sansonetti, D., Fleming, J., Patterson, F., Lannin, N. A., & Toglia, J. (2024). Online awareness: A concept analysis and review of assessment approaches for adults with neurological conditions. *Disability and Rehabilitation*, 1–16, 1–16. https://doi.org/10.1080/09638288.2024.2338876.

Schmidt, M. (1996). *Rey auditory verbal learning test: A handbook*. Los Angeles: Western Psychological Services.

Schmitter-Edgecombe, M., Cunningham, R., McAlister, C., Arrotta, K., & Weakley, A. (2021). The night out task and scoring application: An ill-structured, open-ended clinic-based test representing cognitive capacities used in everyday situations. *Archives of Clinical Neuropsychology*, 36(4), 537–553. https://doi.org/10.1093/ARCLIN/ACAA080.

Schmitter-Edgecombe, M., Parsey, C., & Lamb, R. (2014). Development and psychometric properties of the instrumental activities of daily living: Compensation scale. *Archives of Clinical Neuropsychology : The Official Journal of the National Academy of Neuropsychologists*, 29(8), 776–792. https://doi.org/10.1093/arclin/acu053.

Sherer, M., Bergloff, P., Boake, C., High, W., & Levin, E. (1998). The awareness questionnaire: Factor structure and internal consistency. *Brain Injury*, 12(1), 63–68. https://doi.org/10.1080/026990598122863.

Shimamura, A. P. (2000). Toward a cognitive neuroscience of metacognition. *Consciousness and Cognition*, 9(2), 313–323. https://doi.org/10.1006/ccog.2000.0450.

Stuss, D. T., & Alexander, M. P. (2000). Executive functions and the frontal lobes: A conceptual view. *Psychological Research*, 63(3–4), 289–298. https://doi.org/10.1007/S004269900007.

Sunderaraman, P., Chapman, S., Barker, M. S., & Cosentino, S. (2020). Self-awareness for financial decision-making abilities in healthy adults. *PLoS One*, 15(7), e0235558. https://doi.org/10.1371/journal.pone.0235558.

Swanton, R., Gustafsson, L., Froude, E., Hodson, T., McInerney, M., Cahill, L. S., et al. (2020). Cognitive strategy training for adults with neurological conditions: A systematic review and meta-analysis exploring effect on occupational performance. *British Journal of Occupational Therapy*, 83(12), 723–740. https://doi.org/10.1177/0308022620933095.

Tiznado, D., Clark, J. M. R., & McDowd, J. (2021). Cognitive predictors of a performance-based measure of instrumental activities of daily living following stroke. *Topics in Stroke Rehabilitation*, 28(6), 401–409. https://doi.org/10.1080/10749357.2020.1834269.

Toglia, J. (2015). *Weekly calendar planning activity: A performance test of executive function*. Bethesda, MD: AOTA Press.

Toglia, J., & Foster, E. R. (2022). *The multicontext approach to cognitive rehabilitation: A metacognitive strategy intervention to optimize functional cognition*. Columbus, OH: Gatekeeper Press.

Toglia, J., & Goverover, Y. (2022). Revisiting the dynamic comprehensive model of self-awareness: A scoping review and thematic analysis of its impact 20 years later. *Neuropsychological Rehabilitation*, 32(8), 1676–1725. https://doi.org/10.1080/09602011.2022.2075017.

Toglia, J., Johnston, M. V., Goverover, Y., & Dain, B. (2010). A multicontext approach to promoting transfer of strategy use and self regulation after brain injury: An exploratory study. *Brain Injury*, 24(4), 664–677. https://doi.org/10.3109/02699051003610474.

Toglia, J., & Kirk, U. (2000). Understanding awareness deficits following brain injury. *NeuroRehabilitation*, 15(1), 57–70. https://doi.org/10.3233/nre-2000-15104.

Toglia, J., & White, S. (2020). The weekly calendar planning activity. In Hemphill-Pearson, C. K. U. B. J. (Ed.), *Assessments in occupational therapy mental health: An integrative approach* (4th ed., pp. 239–259). Thorofare, NJ: Slack Incorporated.

Torralva, T., Roca, M., Gleichgerrcht, E., López, P., & Manes, F. (2009). INECO frontal screening (IFS): A brief, sensitive, and specific tool to assess executive functions in dementia. *Journal of the International Neuropsychological Society*, 15(5), 777–786. https://doi.org/10.1017/S1355617709990415.

Tyson, B. T., Pham, M. T., Brown, N. T., & Mayer, T. R. (2012). Patient safety considerations in the rehabilitation of the individual with cognitive impairment. *Physical medicine and rehabilitation. Clinics*, 23(2), 315–334. https://doi.org/10.1016/j.pmr.2012.02.007.

Villalobos, D., Bilbao, Á., López-Muñoz, F., & Pacios, J. (2019). Improving self-awareness after acquired brain injury leads to enhancements in patients' daily living functionality. *Brain Impairment*, 20(3), 268–275. https://doi.org/10.1017/BrImp.2019.10.

Villalobos, D., Caperos, J. M., Bilbao, Á., Bivona, U., Formisano, R., & Pacios, J. (2020). Self-awareness moderates the association between executive dysfunction and functional independence after acquired brain injury. *Archives of Clinical Neuropsychology : The Official Journal of the National Academy of Neuropsychologists*, 35(7), 1059–1068. https://doi.org/10.1093/ARCLIN/ACAA048.

Villalobos, D., Caperos, J. M., Bilbao, Á., López-Muñoz, F., & Pacios, J. (2021). Cognitive predictors of self-awareness in patients with acquired brain injury along neuropsychological rehabilitation. *Neuropsychological Rehabilitation*, 31(6), 983–1001. https://doi.org/10.1080/09602011.2020.1751663.

Warrington, E. K., & James, M. (1991). *The visual object and space perception battery, Thames Valley test company*. Edmunds, UK: Bury St.

Weinstein, C. E., Acee, T. W., & Jung, J. (2011). Self-regulation and learning strategies. *New Directions for Teaching and Learning*, 2011(126), 45–53. https://doi.org/10.1002/tl.443.

Yeo, Y. X., Pestell, C. F., Bucks, R. S., Allanson, F., & Weinborn, M. (2021). Metacognitive knowledge and functional outcomes in adults with acquired brain injury: A meta-analysis. *Neuropsychological Rehabilitation*, 31(3), 453–478. https://doi.org/10.1080/09602011.2019.1704421.

Zimmermann, N., Mograbi, D. C., Hermes-Pereira, A., Fonseca, R. P., & Prigatano, G. P. (2017). Memory and executive functions correlates of self-awareness in traumatic brain injury. *Cognitive Neuropsychiatry*, 22(4), 346–360. https://doi.org/10.1080/13546805.2017.1330191.

Zlotnik, S., Schiff, A., Ravid, S., Shahar, E., & Toglia, J. (2020). A new approach for assessing executive functions in everyday life, among adolescents with genetic generalised epilepsies. *Neuropsychological Rehabilitation*, 30(2), 333–345. https://doi.org/10.1080/09602011.2018.1468272.

Archives of Clinical Neuropsychology, 2025, 40, 842–857
https://doi.org/10.1093/arclin/acae114
Original Empirical Article