The Breakfast and Dressing Conflict Task: Preliminary evidence of its validity to measure Online Self-awareness after Acquired Brain Injury.

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Abstract

OBJECTIVE. We aimed at providing preliminary evidence of the validity of the Breakfast and Dressing Conflict Task (BD-Conflict-Task) to assess online self-awareness (SA, i.e. awareness of the performance in the context of a given task) in acquired brain injury (ABI) patients and to study its interactions with offline SA (i.e. general awareness or metacognitive knowledge). In addition, we tested the validity of a simplified measure of performance monitoring relevant for clinical practice, the ADL-Conflict-Monitoring-Index.

METHOD. ABI patients performed the Breakfast-Task (N=29) and the Dressing-Task (N=23) among distractors and conflicting situations. The variables emergent-awareness, self-regulation, anticipatory-awareness and self-evaluation were collected, and their convergent validity and relationship with offline-SA were analysed. The ADL-Conflict-Monitoring-Index was calculated and its convergent validity was tested.

RESULTS. The online-SA variables of the BD-Conflict-Task showed convergent validity with traditional online-SA measures in both tasks. Significant correlations were found between offline-SA and emergent and anticipatory-awareness in the Breakfast Task. The ADL-Conflict-Monitoring-Index proved to be a valid measure for patients' performance monitoring.

CONCLUSION. These preliminary findings suggest that the BD-Conflict-Task is a valid tool to assess online-SA in ABI patients and provide further understanding of the online-offline SA interaction. Furthermore, the ADL-Conflict-Monitoring-Index proposed here may be a valid and easy-to-use monitoring measure in clinical settings.

Keywords: online self-awareness; acquired brain injury; activities of daily living; assessment.

Introduction

Impaired self-awareness (SA) after acquired brain injury (ABI) is a severe complication that compromises the patient's functional outcomes (Fischer et al., 2004). The Dynamic Comprehensive Model of Awareness (DCMA, Toglia & Kirk, 2000) describes SA as a multicomponent construct. Metacognitive knowledge is the offline-SA component that contains almost stable semantic knowledge stored in long-term memory about tasks' characteristics and our abilities to perform them. The online-SA component constitutes a group of processes activated during the execution of a given task and is composed of "*emergent-awareness*" (error detection), "*self-regulation*" (error correction), "*anticipatory-awareness*" (the ability to predict the incoming task performance) and "*self-evaluation*" (the appraisal of our performance immediately after the task). One key aspect of the model is the interaction between offline-SA and online-SA through an "*updating*" process, which consists in the integration of the information derived from our present performance within our prior metacognitive knowledge.

A recent review about the DCMA (Toglia & Goverover, 2022) highlights the importance of developing new assessment tools that enable the evaluation of all the online-SA subcomponents in the context of the same functional task. Most studies have used laboratory tasks or neuropsychological tests to measure online-SA (O'Keeffe et al., 2007; Robertson & Schmitter-Edgecombe, 2015). The lack of patients' previous experience with these artificial tasks, limits its validity to measure online-SA, since performance prediction, monitoring and self-evaluation cannot be based on prior task knowledge. Additionally, these tasks may not reflect real online-SA deficits when patients' face familiar and meaningful tasks in their daily living. Few studies have proposed assessment tools of online-SA within the context of ADL tasks (Arora et al., 2021; Chudoba & Schmitter-Edgecombe, 2020; Doig et al., 2017;

Giovannetti et al., 2002). Nevertheless, to the best of our knowledge, none of them have measured all online-SA components proposed by the DCMA.

Furthermore, in order to study the potential online-offline SA relationship, a tool that assesses all online-SA components in the context of functional tasks will be more appropriate, since offline-SA is typically assessed with questionnaires about the patient's difficulties with functional activities (Al Banna et al., 2016).

However, an inherent difficulty of the evaluation of online-SA with performance-based ADL tasks is that emergent-awareness and self-regulation are usually measured based on the patient's ability to detect and correct errors that occur spontaneously along the task and that cannot be predicted by the clinician beforehand. For this reason, patients' performance need to be video-recorded and coded offline, which makes the evaluation highly resource- and time-consuming, preventing its applicability in clinical settings.

We have recently proposed an evaluation protocol in which all online-SA components can be evaluated within the context of the same ADL (Merchán-Baeza et al., 2020). The tool is composed of two ADL tasks (an instrumental ADL [preparing breakfast] and a basic ADL [getting dressed]), both of which include a set of distracting objects and unexpected conflicting situations that must be solved in order to successfully complete the tasks. These distracting and conflicting situations will constitute evoked situations where the evaluator can focus on during the assessment of error/conflict detection and correction.

The main aim of the present study was to provide preliminary evidence of the validity of this protocol to assess online-SA components in ABI patients. Secondly, we aimed at testing the interactional nature of the DCMA, by analyzing the relationship of all online-SA components with offline-SA, measured within the same functional domain. The last aim of this study was to test whether the assessment of emergent-awareness and self-regulation abilities exclusively based on patients' behavior towards evoked distracting and conflicting situations is suitable to assess online-SA in a simplified manner.

We expected to find convergent validity for the online-SA variables of the proposed protocol with traditional online-SA measures. In addition, we expected a pattern of interaction between several online-SA components and offline-SA. Finally we expected emergent-awareness and self-regulation to be validly assessed exclusively focusing on the patient's actions towards distractors and conflicting situations.

Method

Participants

A total of 41 brain injury patients were recruited from Neurological rehabilitation services and ABI associations in the cities of *Granada* and *Málaga*, Spain. The eligibility criteria were: age >18 years, diagnosis of ABI and absence of premorbid psychiatric disease. The exclusion criteria were: presence of aphasia, hemineglect, perception deficits, severe motor impairments in both upper limbs and Mini-Mental State Examination<18 (MMSE, Lobo et al., 1999). These criteria led to the exclusion of 5 patients and another 6 patients did not complete the evaluation. Therefore, a final sample of 30 patients (11 females and 19 males; mean age = 56.7, SD = 12.4; mean years of education = 9.7, SD = 3.5) was included in the study. 26 patients had suffered a cerebrovascular accident (19 ischemic and 7 haemorrhagic) and 4 patients had suffered a traumatic brain injury. A sample of 28 healthy controls (HC; 21 females and 7 males; mean age = 62, SD = 11.6; mean years of education = 11.1, SD = 2.9) participated in the study. One-way ANOVAs revealed no statistically significant differences between groups in terms of age and years of education ($F(1,57) = 2.8$; $p = .10$ and $F(1,57) = 2.7$; $p = .10$, respectively).

The performance of HC was used as reference to assess patients' performance and calculate anticipatory-awareness and self-evaluation variables (see Merchán-Baeza et al., 2020 for the detailed descrition of variables calculation).

The study protocol was registered in ClinicalTrial.gov (NCT03712839) and approved by the Andalusian Ethics Committee for Biomedical Research (AnosognosiaAVD2017, 0056-N-17). Prior to participation, all participants received verbal and written information about the study and gave their written informed consent to participate and to be video-recorded during the evaluation sessions.

Procedure

Socio-demographic (gender, age and years of education) and clinical information (brain damage etiology and time since injury) was collected from all participants.

Measures

The *familiarity* with the protocol's tasks was assessed by asking each patient how often he/she was used to perform each ADL before and after the ABI, where: 1= never, 2= rarely, 3= weekly and 4= every day.

The Rey Verbal Auditory Learning Test (Rey, 1964), Color Trail Test (D'Elia et al., 1996), Key Search (Wilson et al., 1996), INECO Frontal Screening (Torralva et al., 2009) and Controlled Oral Word Association Test (COWAT, Benton & Hamsher, 1976) were administered to assess memory and executive functions. A *Cognitive-Index* was calculated as the average of age-adjusted scores of all neuropsychological tests (excluding the measures used for convergent validity analyses).

Offline-SA was calculated as the discrepancy between the total scores of the patient and significant-other forms of the Patient Competency Rating Scale (*PCRS*; Prigatano, 1996). In addition, the mean rating of the significant-other form was used as the patient's *functionality* measure.

Online-SA: The Breakfast and Dressing Conflict Task (BD-Conflict-Task)

During the BD-Conflict-Task, the participants had to complete the Breakfast-Task (BT) by preparing an orange juice with a teaspoon of sugar and a butter-and-jelly toast, whereas the Dressing-Task (DT) was completed by dressing up the upper-body to go out in a rainy day. Four distractor objects semantically related to the target task (i.e., objects to make a cup of coffee with milk in the BT and objects to dress up to go to bed or to dress up the lower-body in the DT) and four unexpected conflicting situations (e.g., unplugged appliances in the BT and clothes presented inside out in the DT) were introduced in each task. All mistakes made during performance were classified according to the level of awareness. Immediately before and immediately after tasks performance the participant was asked to make a prediction and an evaluation of their performance on a 4-point Likert scale. See Merchán-Baeza (2020)for the detailed description of target objects, distractors, conflicting situations, administration procedure, error classification and online-SA variables calculation.

The online-SA variables derived from the BD-Conflict-Task and the corresponding traditional measures used for convergent validity are described in Table 1.

Table 1. Online-SA measures of the BD-Conflict-Task and traditional online-SA measures

Measures of the Breakfast and Dressing Conflict Task	Traditional measures
Emergent-awareness: percentage of detected errors (sum of all spontaneous errors and conflicting situations detected and/or anticipated by the participant divided by the total error including all conflicting situations). ***Self-regulation*:** percentage of corrected errors (sum of spontaneous errors and conflicting situations efficiently corrected and/or anticipated by the participant divided by the total detected and/or anticipated errors and conflicting situations).	***COWAT-Monitoring:*** sum of intrusion and perseveration generated divided by total words generated in COWAT-Phonetic (Robertson & Schmitter-Edgecombe, 2015).
***Anticipatory-awareness*:** difference between patient's estimation of their performance prior to the task and the actual patient's performance, ranging from 4 (maximum anticipatory overestimation) to -4 (maximum anticipatory underestimation).	
***Self-evaluation*:** difference between patient's evaluation of their performance immediately after the task and their actual performance, ranging from 4 (maximum self-evaluation overestimation) to -4 (maximum self-evaluation underestimation).	***Short-term-memory score:*** sum of the words recalled immediately after list presentations in the Rey Auditory Verbal Learning Test (5 trials).

An *ADL-Conflict-Monitoring-Index* was calculated for the patient's behavior towards distractors and conflicting situations in the BD-Conflict-Task, taking into account the patient's detection/correction capacity. Each conflicting situation and action with distractors was scored as follow: 0=the participant anticipated the conflicting situation/no use of distractor; 1=the participant detected the conflicting situation/use of distractor and efficiently corrected it; 2=the participant detected the conflicting situation/use of distractor but could not efficiently correct it; 3=the participant did not detect the conflicting situation/use of distractor or detected it but did not try to correct it. The percentage of errors with distractors was calculated as the patient's score of distractors use divided by the total possible score of distractors use. Although the number of conflicting situations was always the same within the task, not all the participants faced them all. Therefore, the percentage of errors with conflicting situations was calculated as the patient's score of conflicting situations divided by the maximum score the patient could obtain based on the number of faced conflicting situations. The ADL-Conflict-Monitoring-Index was the sum of the percentages of errors with distractors and conflicting situations, where greater scores indicate worse conflict/error monitoring.

We also calculated the Updating variable as the difference between the delayed self-evaluation (20-30 minutes after the task completion) and the immediate self-evaluation. However, the delayed self-evaluation was available only for 15 patients in the BT and 13 patients in the DT, and it showed small variance. Therefore, this measure was excluded from the final analyses.

A total of 29 patients formed the final sample for the BT (one patient was excluded, who, due to cultural background, was not familiar with the task) and 23 patients performed the DT. Few neuropsychological data were missing (8.5%) and were not replaced with any values. Eleven patients missed the COWAT-Monitoring and 4 patients the significant-other PCRS form and thus they were excluded from the corresponding analysis.

Plan analysis

All analyses were performed with IBM SPSS version 28.0. Inter-rater reliability for error classification was analyzed on 20% of the sample (randomly selected). Spearman's correlations were used due to the non-normal distribution of the data. The relationship between the online-SA variables of the BD-Conflict-Task and socio-demographic and clinical variables was analyzed with two-tailed correlations. Convergent validity for each of the online-SA variables of the BD-Conflict-Task was tested with one-tailed correlations. For variables that significantly correlated with demographic or clinical variables, these correlations were repeated controlling for such variables. The online-offline SA relationship was studied with one-tailed correlations. Convergent validity of the ADL-Conflict-Monitoring-Index was analyzed with one-tailed correlation with the COWAT-Monitoring. Alpha was set at 0.05 and Benjamini-Hochberg correction was applied to control for multiple comparisons, since it demonstrates higher power compared to other correction methods (Benjamini & Hochberg, 1995; Olejnik et al., 1997).

Results

The patients' and HC demographic and neuropsychological information, as well as the patients' clinical information, is reported in Table 2. The groups did not differ in terms of age or education. Compared to HC, the patients showed significantly impaired performance in five of the six administered neuropsychological tests.

Table 2. Patients' and healthy controls' characteristics

	Patients N=30	**Controls N=28**	**F** (**p* < .05)
Mini-Mental State Examination	27 (2.3)	28.9 (1)	8.4*
INECO	16.5 (5.4)	22 (4.9)	13.1*
Color-Trail-Test			
Errors	0.7 (0.9)	0.1 (0.4)	7.9*
Near-Misses	0.3 (0.6)	0.2 (0.5)	<1
B-A time (seconds)	95.2 (109.4)	68 (43.2)	2.5
Key-Search	1.3 (1.4)	2 (1.3)	3.1
COWAT			
Phonetic	16 (10.2)	38.6 (15.5)	24.6*
Semantic	12.6 (5.4)	22.7 (9.6)	14*

Rey Verbal Auditory Learning Test				
Short-Term Memory	33.4 (13.4)		47.3 (9.4)	18*
Delayed Memory	5.4 (4.6)		10.6 (2.5)	23.1*
Time since injury (months)	33.4 (54.5)			
Functionality	3.5 (.8)			
Patient's Competency Rating Scale Discrepancy-Index	20.8 (28.9)			
Familiarity	*After brain injury*	*Before brain injury*		
Breakfast-Task	2.02	2.9	3	
Dressing-Task	4	4	4	

The raters obtained ICC > .85 in codifying errors as *detected* and *corrected* in both tasks.

Patients' scores on the BD-Conflict-Task are reported in Table 3.

Table 3. Patients' scores in the BD-Conflict-Task

	Breakfast-Task Median (Range)	**Dressing-Task Median (Range)**
Total Errors	8 (1-27)	3 (0-9)
Emergent-awareness	66.7 (7.1-100)	75 (33.3-100)
Self-regulation	80 (0-100)	100 (33.3-100)
Anticipatory-awareness	1 (-2-4)	1 (0-3)
Self-evaluation	1 (-1-4)	1 (-1-3)
ADL-Conflict-Monitoring-Index	22.2 (5.9-119.6)	33.3 (0-79.2)

Correlations between the BD-Conflict-Task online-SA variables and demographic and clinical variables are reported in Table 4. None of the variables were significantly correlated with years of education or functionality, reported by significant-others. Age correlated with emergent-awareness, self-regulation and anticipatory-awareness in the BT and time since injury with anticipatory-awareness and self-evaluation in the DT. The Cognitive-Index significantly correlated with all online-SA variables in both tasks, except for self-regulation in the DT. Only the correlations involving the Cognitive-Index and the correlation between anticipatory-awareness and time since injury in the DT survived the Benjamini-Hochberg correction.

Table 4. Online-SA correlations with sociodemographic, clinical and cognitive variables

		Age	**Years of Education**	**Time Since Injury**	**Functionality**	**Cognitive-Index**
Breakfast-Task	Emergent-awareness	-.39*	.15	.26	.27	.55**[1]
	Self-regulation	-.42*	.23	-.03	.13	.52**[1]
	Anticipatory-awareness	.37*	-.28	.02	-.29	-.60**[1]
	Self-evaluation	.35	-.16	-.16	-.29	-.54**[1]
	ADL-Conflict-Monitoring-Index	.26	-.25	.04	-.33	-.54**[1]
Dressing-Task	Emergent-awareness	-.27	.36	.17	.28	.81**[1]
	Self-regulation	-.19	.20	.17	-.01	.31
	Anticipatory-awareness	.31	-.13	-.54*[1]	.05	-.60**[1]
	Self-evaluation	.37	-.25	-.51*	.02	-.66**[1]
	ADL-Conflict-Monitoring-Index	.24	-.33	-.03	-.08	-.69**[1]

* = p<.05; **=p<.01 (two-tailed); 1= significant after Benjamini-Hochberg correction

Convergent validity

Emergent-awareness significantly correlated with the COWAT-Monitoring in both the BT (N=18) *Rho* = -.64, *p* =.002 and the DT (N=14) *Rho* = -.52, *p* = .027. The correlations of self-regulation with the COWAT-Monitoring did not reach significance: BT *Rho* = -.30, *p* =.12; DT *Rho* = -.19, *p* = .26. Self-evaluation significantly correlated with short-term-memory in the BT (N=28) *Rho* = -.45, *p* = .008 and DT (N=22) *Rho* = -.69, *p* < .001. All significant correlations survived the Benjamini-Hochberg correction. When controlling for the Cognitive-Index, the correlation between emergent-awareness and the COWAT-Monitoring remained significant in the BT *Rho* = -.58, *p* = .007, but not in the DT *Rho* = -.13, *p* = .33. The correlations between self-evaluation and short-term-memory were not significant after controlling for the Cognitive-Index, neither in the BT *Rho* = -.03, *p* = .44 nor in the DT *Rho* = -.35, *p* = .06.

Online-offline SA relationship

Regarding the BT (N=26), offline-SA significantly correlated with emergent-awareness *Rho* = -.35, *p* = .038 and anticipatory-awareness *Rho* = .47, *p* = .008. Offline-SA correlation with self-evaluation was marginally significant *Rho* = .33, *p* = .05, while its correlation with self-regulation was far from significance *Rho* = -.01, *p* = .47. Offline-SA correlation with anticipatory-awareness was the only correlation that survived the Benjamini-Hochberg correction. None of the correlations between offline-SA and online-SA components in the DT (N=19) reached significance (emergent-awareness *Rho* = -.28, *p* = .24; self-regulation *Rho* = .09, *p* = .72; anticipatory-awareness *Rho* = .18, *p* = .45; self-evaluation *Rho* = .15, *p* = .53).

The ADL-Conflict-Monitoring-Index

The ADL-Conflict-Monitoring-Index was significantly correlated with the COWAT-Monitoring in both tasks: BT *Rho* = .65, *p* =.002; DT *Rho*=.57, *p*=.016. After controlling for the Cognitive-Index, the correlation maintained its significance in the BT, *Rho* = .59, *p* = .007, but not in the DT, *Rho* = .19, *p* = .269.

Discussion

The main aim of the present study was to provide preliminary evidence of the validity of an evaluation protocol based on ADL performance to assess online-SA in ABI patients. To this end, the patients performed the Breakfast and Dressing Conflict Task and measures of online-SA were analyzed.

The patients were familiar with the BT and the DT, favoring the general applicability of the protocol used in this study. The online-SA variables in the two tasks did not show significant correlations with years of education, indicating that the protocol may be a valid tool to assess online-SA in ABI regardless of the patients' education level.

Moderately significant correlations were found between online-SA and age in the BT, which is in line with previous studies that identified age as affecting some online-SA components in complex functional tasks (Arora et al., 2021). Time since injury strongly correlated with anticipatory-awareness and self-evaluation in the DT, favoring the idea that task practice improves online-SA (Doig et al., 2017; Goverover et al., 2014). Dressing is one of the first ADL trained during the rehabilitation, and patients that had more practice with the task after the ABI onset might be more aware of their abilities/difficulties, showing more accurate performance prediction and evaluation. The lack of significant correlations between online-SA and functionality is at odds with previous studies that describe SA as being related with functionality (Goverover, 2004; Villalobos et al., 2020). However, these studies also reveal that the relationship between SA and functionality is highly influenced by other cognitive factors. Indeed, online-SA variables strongly correlated with the Cognitive-Index (including executive and memory functions), which is fully congruent with previous studies that report executive and memory associations with online-SA in ABI patients (Bivona et al., 2008; Ciurli et al., 2010; Goverover, 2004; O'Keeffe et al., 2007; Zimmermann et al., 2017). Future research is necessary to elucidate the potential relationship between cognitive factors, functionality, and online-SA measured with the present ADL tasks.

Convergent validity

Importantly, the online-SA measures derived from the BD-Conflict-Task showed convergent validity with traditional measures assessing the corresponding online-SA components. As predicted, emergent-awareness strongly correlated with the COWAT-Monitoring in both tasks, indicating that these indexes are valid to measure performance monitoring processes within the context of familiar ADL. However, self-regulation measures did not significantly correlate with the COWAT-Monitoring for any of the tasks. This dissociation is in line with the DCMA, which indicates that emergent-awareness and self-regulation are two different subcomponents within online-SA. The correlation of emergent-awareness with the COWAT-Monitoring maintained its significance even after controlling for the Cognitive-Index in the BT, which shows that the emergent-awareness index of this task, despite its strong correlation with other cognitive processes, constitutes a measure of a genuine monitoring process that can be specifically altered after ABI. The fact that the convergent validity of emergent-awareness disappeared for the DT when controlling for the Cognitive-Index may indicate that, while error detection relies on more specific monitoring processes in complex instrumental tasks, in easier basic tasks such as dressing, error detection seems to be largely mediated by other cognitive deficits. Self-evaluation strongly correlated with short-term memory in both tasks, which is highly congruent with our predictions. However, these correlations disappeared when controlling for the Cognitive-Index in both tasks. These results are in agreement with the DCMA, for which self-evaluation is the immediate evaluation of the performance, although it also involves other cognitive processes, such as the comparison of the actual performance with the expected performance, its integration with previous knowledge and a self-reflection to understand the consequences of performance difficulties.

Online-Offline SA relationship

The proposed protocol also allowed testing, in a more direct manner, whether and which online-SA components are related to offline-SA, with all measures being related to the functional domain. In the BT, a significant correlation emerged between emergent-awareness and offline-SA. This finding is congruent with the DCMA, which affirms that there is a dynamic interaction between these components, since, based on our experiences with specific tasks, we create and/or change our beliefs about our abilities to perform that task. Therefore, patients that show poor performance monitoring may not integrate an appropriate reflection of their current abilities into previous metacognitive knowledge. A significant positive correlation was also found between anticipatory-awareness and offline-SA. This correlation is also congruent with the DCMA. Anticipatory-awareness allows predicting our performance on a specific task based on the information we have in metacognitive knowledge (Toglia &

Kirk, 2000). Therefore, anticipatory-awareness strictly depends on offline-SA, and patients that underestimate their deficits "offline" may also underestimate the difficulties they will face when performing a given task.

No significant online-offline SA correlations were found in the basic DT. A possible explanation for the lack of significant results in the DT might be that the questionnaire used in the present study (i.e., PCRS) assesses offline-SA by asking about patient's abilities involved to a greater extent in instrumental ADL. Furthermore, as is proposed by the DCMA, SA might change depending on the task performed, and different factors may affect the online-offline SA relationship in basic and instrumental ADL (Toglia & Goverover, 2022).

The ADL-Conflict-Monitoring-Index

We also tested the ADL-Conflict-Monitoring-Index, which is a new simplified index of online-SA. This index showed the same convergent validity with the COWAT-Monitoring as the most extensive assessment of patient's detection of spontaneous errors. Importantly, the assessment of this index is much simpler during task execution, since the assessor's attention needs to focus on a closed number of patient's behaviors. For this reason, this index can be a valuable and easy-to-use measure of performance monitoring in clinical practice.

Limitations

The present study has several limitations. Firstly, due to the situation created by the COVID-19 pandemic, we could not recruit the planned sample and administer all the proposed tests described in the published protocol (Merchán-Baeza et al. 2020). Consequently, our small sample size diminished the power to detect small effects, preventing the generalization of the findings. Nevertheless, an a posteriori sensitivity analysis with G*Power (Faul et al., 2007) showed that our smallest samples (those regarding the convergent validity with the COWAT-Monitoring) were sufficient to detect moderate effects of r = .40 in the BT (N = 18) and r = .46 in the DT (N = 14), with α = 0.5 and 1-β = .80. Furthermore, we could test the a priori established hypothesis, enhancing the statistical power of the analyses. However, further studies are required to confirm the reliability and generalizability of the present preliminary results. In addition, the fact that the updating measure showed little variance in both tasks, and that it was only available for few patients, limited the possibility to study it. Future studies including a longer time span between immediate and delayed self-evaluation (i.e., 1 hour) might be more sensitive to isolate specific alterations in delayed self-evaluation (Stewart et al., 2010).

Implications for Occupational Therapy practice

The present study offers an ecological ADL-based evaluation protocol to assess online-SA in ABI patients within naturalistic tasks. Additionally, a new method to easily identify patients' monitoring deficits useful in clinical settings is proposed.

The study shows promising results, although further research with larger samples is needed to confirm their reliability and generalizability.

Conclusions

The present study provides preliminary evidence of the validity of an evaluation protocol to assess all the online-SA components in ABI patients in the context of the same ADL. In addition, empirical evidence that supports the DCMA is provided, enhancing the understanding of the interaction pattern between online-SA and offline-SA. In addition, we propose a new valid simplified measure (i.e., the ADL-Conflict-Monitoring-Index) to assess performance monitoring that can be easily used in clinical practice (where usually only offline-SA is evaluated) by occupational therapists and other health professionals.

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