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Self-Awareness Multilevel Assessment Scale (SAMAS): psychometric analysis of inter-rater reliability

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Abstract

Background. Severe acquired brain injury (sABI) frequently causes impairment in self-awareness (ISA), leading to reduced patients' compliance to treatment, worse functional outcome, and high caregiver distress. Self-awareness (SA) is a multilevel and complex function that, as such, requires a specific and effective assessment. To date, many tools are available to evaluate the declarative, but not emergent and anticipatory levels of awareness, therefore the Self-Awareness Multilevel Assessment Scale (SAMAS) was recently proposed. The new tool proved to be useful to assess SA at different levels across all domains of functioning (motor, cognitive, psycho-behavioural, etc.) because it measures not only the declarative SA, but also emergent and anticipatory levels of SA, thus overcoming some important limits of other current assessment methods.

Aim. This study evaluated the inter-rater reliability (IRR) of the SAMAS.

Methods. Four professionals blind to each other evaluated 12 patients with sABI. Each patient was rated by two professionals.

Results. Inter-rater reliability was moderate-to-excellent, adding evidence in support of the use of SAMAS to specifically diagnose ISA after sABI.

Conclusions. The SAMAS can help to better address neurorehabilitation, as it allows assessing ISA as early as possible, at all possible levels of awareness and functional domains.

Key words

- severe acquired brain injury
- anosognosia
- self-awareness
- assessment
- neurorehabilitation
- psychometry
- inter-rater reliability

INTRODUCTION

Self-awareness (SA) is frequently impaired after a severe acquired brain injury (sABI) [1-3]; therefore, in neurorehabilitation it is fundamental having an as early and as much accurate as possible assessment of SA after sABI. Impaired self-awareness (ISA) has been associated to dysexecutive syndrome [4, 5], apathy or anosodiaphoria [6-10], reduced subject's compliance to treatment, worse functional outcome [11-19], and caregiver distress [20].

However, some issues are still debated in the literature. In fact, ISA is a multifaceted concept, which to date remains not fully understood. Two main explanatory models have been proposed. Firstly, Crosson *et al*. [21] posited a pyramidal model consisting of three interdependent and hierarchical levels, namely a) intellectual awareness, i.e. the subject's ability to understand (mostly thanks to external feedbacks) and refer that a function is impaired; b) emergent awareness, i.e. a subsequent ability to recognize problems when they happen; and c) anticipatory awareness, i.e. the final ability to anticipate that a problem will occur due to the deficit already known by the patient at the two previous levels [21]. More recently, Toglia and Kirk [22] proposed an alternative Dynamic Comprehensive Model of Awareness (DCMA) that, rather than as a series of hierarchical levels, posits the relationship between different aspects of metacognition and awareness as a dynamic process. The DCMA differentiates between: a) metacognitive awareness, i.e. knowledge of task characteristics and knowledge of one's own capabilities (similarly to the concept of intellectual SA of Crosson *et al*. model), and b) online awareness, which can be activated during a task and consists of self-monitoring and recognition of errors (similarly to emergent SA of Crosson *et al*. model), as well as of the person's appraisal of current

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task demands (comparable to anticipatory SA of the same previous model). For the purpose of the present study, we will adopt the term "declarative" SA, referring to both intellectual and metacognitive levels of SA.

A further issue, closely related to the first two, is how to assess at best ISA after sABI. Indeed, many measures are already present in the literature, i.e., clinical observation [23-24]; structured and semi-structured interviews [15, 25]; comparison between patient's self-assessment and their performance on neuropsychological tests [26]; and comparison between patient's self-report and clinician/relative's report [11, 27, 28]. However, all these measures present with some important limits. For example, self-report questionnaires cannot be administered to patients who suffer relevant cognitive deficits, such as aphasia, severe memory deficits or reduced reasoning and judgment abilities. Moreover, questionnaires and interviews can assess mainly declarative awareness, even when they try to investigate anticipatory SA [15]. Indeed, the patients' report can be considered a mere declarative report if not supported by actual and effective behaviours, such as preventing difficulties in daily life, by adopting strategies to cope with them. Accordingly, a report of significant others is necessary to verify that patients are concretely self-aware at an anticipatory level (see [29] for details). Finally, as for emergent SA, the existing measures [25, 30-33] can assess SA only through some standardized tasks, rather than in a more comprehensive and ecological variety of situations directly related to the current patients' difficulties [34].

In a recent study [29] we tried to overcome the limits above mentioned by means of a new measure, namely the Self-Awareness Multilevel Assessment Scale (SAMAS) [29], which can be considered a versatile tool for the assessment of SA at different levels and across several possible domains of functioning (see below for details). Indeed, through the SAMAS, professionals in the neurorehabilitation setting can assess patients' SA at the emergent level, that is regarding their ability to self-monitor online their performance in all possible critical areas of functioning. Moreover (going beyond the merely declarative level), thanks to the contribution of other professionals in the rehabilitation team and of caregivers, the scale allows for investigating the real level of anticipatory SA [29].

The validation study of the SAMAS [29] used two external measures to assess the concurrent validity: a) a gold standard given by a blind clinical judgment of an expert neuropsychologist; b) the correlation between the SAMAS and two of the mainly adopted ISA measures, i.e., the Patient Competency Rating Scale (PCRS) [35] and the Self-Awareness Deficits Interview (SADI; [15]). Our results showed that the SAMAS can be conceived as a valid tool to assess SA since it significantly predicted all dimensions of SA. Indeed, the scale revealed to be able not only to assess declarative SA, but even to specifically and broadly assess both emergent and (actual) anticipatory levels of SA.

In line with our previous study, the aim of the present study was to assess the inter-rater reliability (IRR) of the SAMAS.

MATERIALS AND METHODS

Participants

We recruited twelve patients with severe ABI, consecutively admitted to the Post-Coma Unit of Fondazione Santa Lucia of Rome (Italy) from February 2020 to April 2021. The study was approved by the local Ethics Committee, and all participants and their caregivers were included in the study after providing their (or by one legal surrogate) informed consent.

The inclusion criteria for the patients were: a) age ≥16 years; b) diagnosis of severe ABI (i.e., Glasgow Coma Scale (GCS) score ≤8 in the acute phase); c) score at the level of Cognitive Functioning Scale (LCF) ≥6, with inclusion of the patient according to the judgment of the neuropsychologist involved in the study; d) capacity to undergo a formal psychological evaluation; e) availability of informed consent. Exclusion criteria were: a) history of drug and alcohol addiction; b) psychiatric diseases; c) repeated sABI and/or other neurological disorders.

Sociodemographic and clinical characteristic of patients were: 8 males and 4 females, with a mean age of 45.8 years (SD=14.8; range=46.0; median=48.5; IQR=16.5); mean educational level of 11.8 years (SD=3.6; range=10.0; median=12.5; IQR=5.0); time since injury: from 42 to 386 days, with a mean of 133.5 days (SD=101.0; range=344; median =102.0; IQR=119.0); aetiology of severe ABI was: traumatic brain injury (TBI) (n=5), haemorrhagic stroke (n=3), and ischemic stroke (n=4).

We also recruited one informal caregiver ("caregiver" from now on) for each patient. The inclusion criterion for caregivers was the absence of any current or previous severe neurological or psychiatric disorder.

Self-Awareness Multilevel Assessment Scale (SAMAS)

The SAMAS is a single and comprehensive tool conceived to be administered by a cognitive-behavioural therapist in neurorehabilitation. The SAMAS assesses the different levels of SA (i.e., declarative, emergent, and anticipatory) across all possible domains of functioning (i.e., motor, cognitive, psycho-behavioural, and others – such as phoniatric, dysphagic, etc).

As for the declarative SA, the SAMAS takes into account two aspects, i.e., the patient's recognition of a) the presence of current difficulties (e.g., paresis of a limb and/or memory deficits), and b) of the functional implications of such difficulties (e.g., the patient's impossibility to eat alone and/or to remember what he did in the past day). As for the emergent SA, the SAMAS assesses the patient's online recognition of difficulties in each functional domain (e.g., the patient's ability to realize the impossibility to stand up while trying to do it, and/or to realize difficulty in remembering something while trying to do it). Finally, the anticipatory level takes into account five aspects, i.e.: a) the patient's ability to recognize the problematic nature of a task with respect to his/her own deficits; b) the patient's ability to set realistic goals in relation to his own difficulties; c) the patient's expression of strategies to avoid having difficulties; d) the patient's effective use of such strategies; and e) the

patient's ability to generalize such strategies (when they are used) to all the contexts in which he/she acts.

The SAMAS provides three different scores, one for each level of SA. In particular, the scale includes two items for the declarative, one for the emergent, and five for the anticipatory level of SA. Since each item encompasses the above mentioned four domains (i.e., motor, cognitive, psycho-behavioural, and others), the item score can range from 0 to 8 – being each sub-score for each domain ranging from 0 ("good SA") to 2 ("relevant ISA") – (See [29] for details). In each level assessed by the SAMAS, 0 is assigned when patients show good SA; 1 if they need a cue by the therapist (moderate ISA); 2 when they show no SA despite such cue (severe ISA).

Of note, the SAMAS should be completed with the involvement of the patients' caregiver (by a clinical interview) and of the inter-professional neurorehabilitation team (when necessary), in order to accurately assess all the levels of SA and, in particular, emergent and actual anticipatory SA (see the Procedure section below for details).

Operationally, the examiner fills in the SAMAS form assigning 32 sub-scores (ranging from 0 to 2), for a maximum score of 8 for the declarative, 4 for the emergent, and 20 for the anticipatory level of SA. Regarding the evaluation of the declarative level of SA, each sub-score is established by the examiner based on his/her direct observation of the patient. As for the other two levels of SA, each sub-score is established by the examiner based on information that the same examiner gathers indirectly, that is through other professionals of the neuro-rehabilitation team and/or the caregivers.

Procedure

The study involved four professionals, i.e., two speech therapists expert in cognitive-behavioural neurorehabilitation (GF and SL), and two researcher psychologists expert in clinical neuropsychology (MA and MC). After enrolment, each patient was randomly assigned to a couple composed of one speech therapist and one psychologist, so that each of the couples assessed three different patients according to the scheme reported in *Table 1*.

Therefore, each rater blindly assessed six out of the 12 patients enrolled. In particular, each patient was assessed by the two raters within the same week.

Table 2 shows the assessment scheme for the three levels of SA. In particular, for each patient the declarative and the anticipatory SA were assessed by the two raters separately and in three different sessions: 1) through a clinical interview with the patient; 2) by an interview with the physiotherapist and/or with other members of the neurorehabilitation team (to assess declarative SA by comparing what reported by the patient to what reported by the other therapists concerning the patient's functional impairments); 3) by a clinical interview to the patient's caregiver to assess the actual anticipatory SA. As for the emergent SA, instead, the two raters filled in the SAMAS at the same time in the presence of the patient, based on the need of assessing SA in relation to an (only) objective patient's behaviour, i.e., during the administration of a task related to the real patient's difficulties (e.g., based on what emerged by the patients' medical records, by the rehabilitation staff or by the neuropsychological report); of course, even in this case, each of the two raters filled in the SAMAS in blind.

Statistical analysis

The IRR was calculated as intra-class correlation coefficient (ICC) using a 2-way random effects, single measure (2,1) model, and measured separately for the global (8 items, comprised of 32 sub-scores), the declarative (2 items, 8 sub-scores), emergent (1 item, 4 sub-scores), and anticipatory (5 items, 20 sub-scores) SA levels. The IRR results are shown in *Table 3*.

RESULTS

The IRR results were all significant *(Table 3)* and indicated a good IRR for the overall scale (ICC=0.77). In detail, the IRR was good (ICC=0.76) for the declarative, excellent (ICC=0.92) for the emergent, and moderate (ICC=0.67) for the anticipatory levels. Since the anticipatory level was based also on information gathered from the caregiver, which potentially may have

Table 1
Assessment scheme of each patient for each of the four couples of raters

Couple speech therapist/ psychologist	Patients blindly assessed
Rater 1: GF - Rater 2: MA	"a", "b" and "c"
Rater 1: GF - Rater 2: MC	"d", "e" and "f"
Rater 1: SL - Rater 2: MA	"g", "h" and "i"
Rater 1: SL - Rater 2: MC	"j", "k" and "l"

GF and SL: Speech Therapists; MA and MC: Psychologists.

Table 2
Assessment scheme for the three levels of Self-awareness (SA)

Level of SA	Rater 1	Rater 2
Declarative	Patient	Patient
	Physiotherapist (and/or other members of the neurorehabilitation team)	Physiotherapist (and/or other members of the neurorehabilitation team)
Emergent	Patient	
Anticipatory	Patient	Patient
	Caregiver	Caregiver

Table 3
IRR separately for the SAMAS global score and the scores of the declarative, emergent, and anticipatory levels. The intercorrelation coefficient – ICC (2,1) – was based on a 2-way random effects model (absolute agreement). The last line reports the IRR for the global score computed excluding the anticipatory level

	Cronbach Alpha	ICC	CI 95%	Test F	p value
SAMAS global score	0.891	0.77	0.36-0.93	9.20	0.000
Declarative level	0.867	0.76	0.37-0.92	7.51	0.001
Emergent level	0.954	0.92	0.74-0.98	21.61	0.000
Anticipatory level	0.836	0.67	0.20-0.89	6.08	0.003
SAMAS global score without anticipatory score	0.916	0.84	0.55-0.95	11.87	<0.001

introduced variability due to different criteria from non-professional observers, the IRR for the global SA was also computed excluding the anticipatory SA subscores, resulting in a better ICC (0.84) *(see Table 3)*.

DISCUSSION

As it is well known, ISA is the first obstacle to neurorehabilitation and in many cases it long-lasts, thus dramatically hampering not only the quality of life of the patients with sABI, but even more that of their family system [14, 36-42]. Accordingly, an early and accurate diagnosis of ISA allows for better addressing the ISA treatment and reducing the possible primary and secondary implications of this disturbance.

The aim of the present study was to evaluate the IRR of the SAMAS, a new tool recently developed to assess declarative, anticipatory, and emergent dimensions of SA in persons with sABI. The SAMAS has already proved [29] to be able to assess specifically and broadly not only declarative but also emergent and (actual) anticipatory SA, thus overcoming the lack of tools in measuring the last two levels.

The present study revealed an overall moderate-to-excellent agreement between the blind raters for each of the four couples of professionals. Therefore, in line with the first study on the psychometric properties of the SAMAS [29], the present study showed good results in terms of IRR of the scale, thus increasing the strength of the scale.

Admittedly, as for anticipatory SA, the Cronbach's Alpha and ICC indexes were sensibly lower than those related to declarative and emergent SA. This result may be due to the higher complexity in assessing anticipatory SA with respect to the other SA levels. Indeed, as above mentioned, the assessment of this level requires not only an online assessment (i.e., in the presence of the patients, as for the assessment of declarative and emergent SA) but even an offline assessment aimed at verifying, by mean of other significant reports, what was previously stated by the patients at a merely declarative level (see [29] for details). This further investigation could likely enhance the variability of the data collected. In particular, the main witnesses involved in the assessment of the anticipatory SA are usually the informal caregivers, who in many cases can show psychological defence mechanisms (such as denial) [37], related to a poor acceptance of the dramatic functional changes that occurred in their loved-one. Therefore, in assessing this level of SA, caution is needed through an accurate clinical observation of the caregivers themselves, to evaluate their viewpoint as an external confirmation of what is reported by the patients.

However, the present study confirmed the utility of the SAMAS as an innovative and comprehensive measure of SA that, if supported by careful interviews with other members of the neurorehabilitation team (e.g., occupational therapists, speech therapists, physiotherapists) and the informal caregivers, could help the neuropsychologist and the cognitive-behavioural therapists in assessing at best one of the main obstacles in rehabilitation, that is ISA.

We acknowledge that the present study presents with some limitations. First, the small sample size requires caution in considering data on the SAMAS IRR as definitive. Indeed, we considered our results preliminary and further studies with larger samples of patients are necessary to corroborate them. However, we would also underline that despite the small sample size, thanks to our inclusion criteria (i.e., LCF scores ≥6) this group of patients likely represents the overall population of patients with full recovery of consciousness, admitted to the Post-Coma Unit of Fondazione Santa Lucia.

Second, we tested the IRR of the SAMAS on four professionals, but each patient has not been evaluated by all the possible combinations of couples of raters, as in a fully crossed design. Nevertheless, to reduce such variability, we designed the data collection by ensuring that each of the four couples of professionals could rate the same patients at least in three different cases. A limit of the scale is that none of the studies conducted to date on the SAMAS assessed the intra-rater reliability. Therefore, the use of the scale requires caution, until further studies will confirm the psychometric qualities of the SAMAS. Finally, it must be reminded here that we administered an Italian version of the SAMAS. Further studies, possibly conducted in other countries on the same population of patients are needed to test the cross-cultural validation of the SAMAS.

Despite the limitations above, we would underline the usefulness of utilizing SAMAS to assess all levels of SA in neurorehabilitation, particularly with respect to the emergent and declarative SA.

CONCLUSIONS

Given the lack to date of specific tools capable of assessing emergent and anticipatory SA (which are as rel-

evant as the declarative level for a successful therapy), the SAMAS is the result of our attempt to help neurorehabilitation professionals quantitatively describing what they usually observe in the neurorehabilitation setting. Unfortunately, as above mentioned, the scale presents still with several limits and, accordingly, requires further validation studies, conducted on larger samples.

Nevertheless, the SAMAS can be considered a useful measure of SA, since it has been conceived within a holistic perspective, which implies a combined use of clinical observation, interviews, and scales, in order to obtain an early and accurate diagnosis of ISA [29], thanks to a multi-disciplinary and inter-professional teamwork. Indeed, we would point out here that the SAMAS requires to be completed within the context of accurate clinical observation, as well as that it also needs an accurate interview with the informal caregivers (to verify their compliance and credibility as external witnesses on what is reported by the patients) and the other members of the inter-professional neurorehabilitation team.

The present study confirmed that this scale can be utilized in neurorehabilitation as a useful measure to specifically assess SA, since to our knowledge it remains to date the only tool in the literature that also allows the assessment of emergent and actual anticipatory SA.

Author's contribution

UB, PC, and AC: conception and design. GF, SL, MA, MC, VB, PLS, and GL: data acquisition. MDL and AC: data analysis and interpretation of results. UB and AC: original draft. RF: project supervision. All Authors read and approved the final version of the manuscript.

Conflicts of interest statement

There are no potential conflicts of interest or any financial or personal relationships with other people or organizations that could inappropriately bias conduct and findings of this study.

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