Validity and reliability of a questionnaire to assess social skills in traumatic brain injury: a preliminary study

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ABSTRACT

Objective: To describe the reliability and validity of a new measure, the Social Skills Questionnaire for Traumatic Brain Injury (SSQ-TBI).

Methods: Fifty-one adults with severe TBI completed the SSQ-TBI questionnaire. Scores were compared to informant- and self-report on questionnaires addressing frontal lobe mediated behaviour, as well as performance on an objective measure of social cognition and neuropsychological tasks in order to provide evidence of concurrent, divergent and predictive validity.

Results: Internal consistency was excellent at α=.90. Convergent validity was good, with informant ratings on the SSQ-TBI significantly correlated with Neuropsychiatric Inventory Disinhibition subscales (*r*=.50 to 63), the Current Behavior Scale (*r*=.39-.48) and Frontal Systems Behavior Scale (*r*=.60-.83). However, no relationship was seen with an objective measure of social skills or neuropsychological tasks of disinhibition. There was a significant relationship with real-world psychosocial outcomes on the Sydney Psychosocial Reintegration Scale-2 (*r* = -.38 to -.69)

Conclusions: This study provides preliminary findings of good internal consistency and convergent and predictive validity of a social skills questionnaire adapted to be appropriate for individuals with TBI. Further assessment of psychometric properties such as test-retest reliability and factor structure is warranted.

Keywords: social skills, social function, traumatic brain injury (TBI), questionnaire

Changes in social and emotional functioning are a common sequelae of traumatic brain injury (TBI), occurring in up to 80% of persons with brain injury [1, 2].These changes include poor emotion recognition, an inability to recognize and respond to emotional cues, self-centredness, lack of empathy, disinterest in others and socially inappropriate behaviour [1-3]. Although survivors and their families are also faced with changes to physical and cognitive functioning, personality and social changes are often rated by families to be one of the most problematic consequences of TBI [4], and are most strongly related to relative stress [5]. Individuals with TBI themselves report their primary concern to be loss of social contacts [6, 7], with almost one third of patients with TBI having no friends outside the family 10 years post-injury [8]. Social changes following TBI result in social isolation, relationship breakdown and decrease in leisure activities [9]. Social impairments are also linked to unemployment [3] and are suggested by researchers to be *the* major challenge facing rehabilitation [9]. Evaluation of social skills is therefore necessary to aid clinicians in the early identification of impairments in social function, and to aid researchers in the evaluation of much needed social skills training interventions.

Despite the prevalence and severity of social skills deficits, standard cognitive measures are primarily non-social in content and therefore do little to detect or characterize the nature of social skills deficits. There are assessment tools that tap social skills and are well established and validated in persons with TBI [10, 11]. However, many are time consuming and there may be problems that emerge in different social contexts that are not elicited in the formal testing environment. As an alternative, questionnaires have been used to assess social function and have benefits of being quick and simple to administer. They have the additional benefit of assessing social competence in a variety of contexts, which is not feasible through assessment in a formal setting.

There are few questionnaires that have been used to assess social functioning in individuals with traumatic brain injury. The Sydney Psychosocial Reintegration Scale [12] is a very useful measure that assesses the effects of TBI on three domains: occupation, leisure activities, and interpersonal relationships. While it has excellent psychometric properties, the items are too broad to determine deficits in specific social skills. Therefore, it is more useful for detecting presence or absence of social dysfunction. Similarly, the Craig Handicap Assessment and Reporting Technique [13] includes a social integration scale, and the widely used Mayo-

Portland Adaptability Inventory [14] includes two items to assess participation in social and recreational activities, but the items for both these scales reflect objective outcomes (e.g. whether the individual lives alone, how many friends they have, whether they have regular contact with friends) rather than social skills per se.

Executive functions are affected in TBI secondary to the multifocal lesions that predominantly affect the frontal lobes along with diffuse axonal damage [15]. Importantly, executive skills such as the ability to flexibly adapt and change behaviour or to disinhibit inappropriate responses have been linked to social competency [16, 17]. As such, questionnaires that focus on executive functioning in TBI have relevance to social skills and, indeed, some have a small number of items to address emotional and personality changes, including the Frontal Systems Behavior Scale [FrSBe; 18], Current Behavior Scale [CBS; 19] and Dysexecutive Questionnaire [20]. However, because these questionnaires are primarily focused on cognitive/executive difficulties their coverage of social skills is limited. While aspects of executive functions such as inhibitory control are required for successful social interactions [21-24], it would be necessary for researchers and clinicians to have a direct measure of the social skills themselves rather than inferring this from executive constructs. Similarly, the Neuropsychiatric Inventory [NPI; 25] and Patient Competency Rating Scale [PCRS; 26] contain a limited subset of items dedicated to social functioning within the measure. To our knowledge, there is no single scale available currently that comprehensively measures a broad range of behaviours related to social abilities. This interpretation is supported by the fact that the common data elements recommendations for use of common measures in TBI research recommends only the CHART short form in the social role and participation domain [27]. As described above, this measure provides only social outcomes rather than being a comprehensive measure of social skills.

There are some measures that were not specifically developed for use in persons with TBI, but have been used to measure social abilities in this population. One available measure is the first subscale of the Katz Adjustment Scale [KAS-R1; 28]. This scale was originally developed for use in mental illness, but has been used in a number of studies with persons with TBI [e.g. 29, 30, 31]. However, it includes a number of psychiatric symptoms that are not relevant to persons with TBI (e.g. paranoid ideation) and is time consuming to administer (126 items). The Social Performance Survey Schedule (SPSS) is a measure of both anti-social

and pro-social behaviour, with good reliability [32] and validity [33]. A major benefit of this scale is the measurement of both positive and negative aspects of social behaviour, which would allow assessment of change in both directions following treatment. However, there are a number of drawbacks regarding use of the scale in TBI. First, the inclusion of 100 items makes the scale very lengthy to administer. Second, two studies using this measure in a TBI population have shown that either the negative items did not distinguish TBI participants from controls (24), or that TBI participants, in fact, had fewer negative behaviours compared to a control population (25). These findings are inconsistent with a wealth of research demonstrating greater social dysfunction in TBI (e.g. 5, 6). Inspection of SPSS items revealed that while some items had face validity for use in TBI, other items were considered inappropriate for detecting typical social impairments in this population. Thus, although this scale has promise for assessment of social skills, modification would be required to ensure its suitability for use in persons with TBI.

The aims of the present study were: a) to modify the SPSS, a useful scale that is sensitive to both positive and negative social behaviours, b) to produce an abbreviated version more useful for clinical assessment (the SSQ-TBI), c) to retain some of the original useful items and include additional items that are more relevant to persons with TBI, and d) to test the psychometric properties of the new scale, specifically internal reliability, construct validity and predictive validity.

With respect to construct validity of the scale, it was hypothesized that the SSQ-TBI would positively correlate (convergent validity) with questionnaires and neuropsychological tasks assessing similar constructs such as social cognition, executive and frontal lobe functioning. As emotion recognition and sarcasm detection skills observed on The Awareness of Social Inference Test (TASIT) have previously been shown to correlate with specific social behaviours observed in the laboratory [34], we hypothesized these would similarly be associated with social functioning reported on the SSQ-TBI. We further expected higher scores on the SSQ-TBI to be associated with executive dysfunction as measured by two questionnaires (FrSBe and CBS). There are a number of reasons to think that social skills deficits should be associated with executive functioning deficits. First, neurological mechanisms of prefrontal cortex lesions (particularly the orbitofrontal cortex) and diffuse axonal injury affecting white matter pathways to the prefrontal cortex are thought to

underlie deficits in both executive functioning and social skills in TBI [35]. Secondly, social interactions are cognitively complex, and demand higher level (executive) abilities such as monitoring and evaluation, adapting to changing contexts, flexibly refocusing attention and inhibiting inappropriate impulses [36].

We additionally administered a questionnaire (Neuropsychiatric Inventory Disinhibition Subscale; NPI-D) and neuropsychological tasks (rule breaks on verbal fluency and sentence completion tasks) to measure one particular aspect of executive functioning, disinhibition. Social disinhibition is a particularly debilitating behavioural change observed following TBI [37, 38] and there is some evidence that the neurocognitive ability to inhibit and modulate responses is associated with social functioning. For example, individuals with TBI who were impaired on rule-breaking variables on fluency and sentence completion tasks show poorer emotional regulation in response to anger-inducing film clips and informant-reported loss of emotional control on the CBS [39, 40]. In contrast, we aimed to show that the SSQ-TBI did not correlate with a measure of intellectual functioning (divergent validity). Finally, it was hypothesized that poorer social skills as measured using the SSQ-TBI would be reflected in poorer psychosocial outcomes (predictive validity) as measured using the SPRS-R, a measure of real-world functioning in the domains of occupation, leisure and relationships [12].

Method

Participants

The relatives of fifty-one adults who had sustained a severe traumatic brain injury were recruited from the outpatient records of three Sydney metropolitan brain injury units, as well as advertisements through acquired brain injury units and online brain injury associations. Injury details were obtained through relative report and, where possible, via medical records. The relatives provided demographic and clinical details about the person with TBI and completed questionnaires related to social functioning. To be included, the family member with TBI had to meet the following criteria: a severe TBI according to the criteria of Teasdale [41; i.e. coma or Post-Traumatic Amnesia (PTA) of at least 24 hours], be discharged from hospital and living in the community, and be proficient in English. Of this group of 51, a sub-sample of 24 individuals with TBI attended the laboratory in person. The FrSBE, neuropsychological tasks and social cognition tasks were administered to the participants with TBI. Upon arrival to the laboratory, these individuals completed information and consent forms and the self-report questionnaire (Frontal Systems Behavior Rating Scale). Neuropsychological and social cognition tasks were presented in the following order; Wechsler Test of Adult Reading, Controlled Oral Word Association Test, Hayling Sentence Completion Task, The Awareness of Social Inference Test. These tests take approximately 50-70 minutes to complete, dependent on the individual, and breaks of 5-10 minutes were provided as needed.

Demographic and injury details of the two samples are presented in Table 1. For the overall sample, post-traumatic amnesia (PTA) ranged from 2 to 279 days (*M*=69.52, *SD*= 54.72), and time post injury ranged from 1 to 46 years (*M*= 12.43, *SD*= 10.36). Mean age was 47.24 (*SD* = 14.17, range: 18 to 70) and average years of education was 12.88 (*SD* = 2.41, range: 9 to 22). Injuries were caused most commonly by car accidents (n = 25), followed by falls (n = 13), motor bike accidents (n = 4), assault (n = 3) or other (n = 6). There were no significant differences between the individuals with TBI who completed further tasks and those who did not, in terms of age (p = .16), education (p = .06), gender (p = .86), duration of PTA (p = .49) or time since injury (p = .07).

Measures

The *Social Skills Questionnaire for Traumatic Brain Injury* (SSQ-TBI) was developed with the aim of meeting the need for a scale to assess social behaviour and skills in persons with TBI. There are 41 items that are completed by a family member or close friend (see Appendix) and rated on a 5-point likert scale, from 1 = *Not at all* to 5 = *Very often.* Development of the items was guided by consideration of behaviours that are important for normal social interactions, as well as behaviours known to be impaired following traumatic brain injury, including emotion recognition [42], empathy, egocentrism, language skills [43]. A final item was included to provide an overall impression of social functioning. This resulted in a final scale with 41 items.

Convergent validity

A clinical measure of social perception was administered to examine relationship between SSQ-TBI scores and social cognition.

The Awareness of Social Inference Test [TASIT; 44] assesses basic emotion perception and social cognition abilities. Participants watch a series of videotaped vignettes of professional actors, and then answer forced-choice questions about the thoughts, feelings, and/or intentions (Theory of Mind; ToM) of a target character. TASIT has three parts: i) TASIT 1: Emotion Evaluation Test, comprises 28 video clips and participants are asked to nominate which of six basic emotions (happiness, sadness, anger, fear, revulsion, surprise, or neutral) a target character is feeling; ii) Test of Social Inference – Minimal, comprises 15 video clips depicting either sincere or sarcastic exchanges, and participants are required to answer four yes/no questions eliciting ToM judgments; iii) Test of Social Inference – Enriched, comprises 16 video clips depicting either sarcastic or deceptive (i.e., lies) exchanges, and participants answer four yes/no questions eliciting ToM judgments. As there are no verbal or contextual cues as to the true meaning of the exchange, the clips require participants to interpret paralinguistic information (i.e., facial expression, tone of voice, body gesture etc.).

Self- and informant-report questionnaires were administered to examine the association between SSQ-TBI scores and executive function.

The Current Behaviour Scale [CBS; 19] consists of informant report of post-TBI behavioural changes which are consistent with disorders of emotion regulation. It consists of 25 items, rated on a 7-point likert scale, divided into two subscales: Loss of Motivation (lowered arousal) and Loss of Emotional Control. The CBS has been previously used in both the mothers and other relatives of adult patients with TBI [19, 45]. It has very good internal reliability [α = 0.80; 46] and has been shown to measure behavioural changes that occur independently of premorbid personality traits [45].

The *Frontal Systems Behaviour Rating Scale* [FrSBe; 18] is designed to measure behavioural changes resulting from frontal systems dysfunction. It consists of 46 items rated on a 5-point likert scale, with three subscales; Apathy (14 items), Disinhibition (15 items) and Executive Dysfunction (17 items). The scale has good internal consistency [α = .92 for the Total Scale and α =.78- .97 for the subscales; 18], test-retest reliability (*r* = .78) and inter-rater reliability [r = .83-.89 for the Total Score and r = .79-.92 for the subscales; 47]. It discriminates individuals with frontal lesions from healthy controls [48].

A questionnaire and two neuropsychological measures were administered to examine the association between SSQ-TBI scores and a specific executive function, inhibition.

The Neuropsychiatric Inventory (NPI) was completed by a family member or close friend and was developed to assess behavioural disturbances in dementia patients and has been used in several TBI studies [25]. The disinhibition subscale (NPI-D) consists of 7 items that explore specific disinhibited behaviours, with follow up questions that assess frequency, severity and level of distress rated on a 4 point likert scale. The NPI has well-established psychometric properties, including good internal consistency (α = .88), inter-rater agreement (93.6-100% for different behaviours) and test-retest reliability (*r*=.79 to .86 for frequency and severity scores). Support for validity of the NPI-D subscale in persons with TBI is demonstrated through several studies. Ciurli [49] showed 28% of patients with TBI exceeded cutoffs for disinhibition, whereas no disturbances in disinhibited behaviour were shown for controls. Presence of disinhibition on the NPI was significantly correlated with degree of impairment

following brain injury measured using the Glasgow Outcome Scale [50]. As individuals with TBI who have orbitofrontal lesions are at particular risk of social deficits, and NPI-D frequency score has been correlated with atrophy in the orbitofrontal cortex, we anticipated a relationship between NPI-D and SSQ-TBI in the present study.

Errors made on the *Controlled Oral Word Association Test* (COWAT)[44] and the *Hayling Sentence Completion Test*[45] error scaled score were used as neuropsychological measures of inhibition. Inhibition on such rule breaking variables has previously been shown to correlate with emotional control [39]. The COWAT requires participants to generate words under either phonemic (C, F, L) or semantic constraints (animals) and errors include complete and partial repetitions of words and rule breaks (i.e. wrong letter or category, proper nouns). A higher error scores therefore represents reduced inability to inhibit 'illegal words'. The *Hayling Sentence Completion Test* requires the subject to complete sentences first with semantically related words (control condition) and then with semantically unrelated words (inhibition condition). Error scores represent a failure to inhibit semantically related words. Impaired performance on this task has been associated with orbitofrontal atrophy [51], a brain region thought to underlie social processing [52].

Divergent validity

The *Wechsler Test of Adult Reading* (WTAR) is a standardised word reading task, which has been shown to be resistant to organic brain injury, reliable (coefficient α = .87–.97) and is designed to provide an estimate of premorbid intellectual functioning [53].

Predictive validity

The Sydney Psychosocial Reintegration Scale 2 (SPRS-2) [12] was completed by a family member or close friend and assesses change in psychosocial functioning from pre- to post-injury across 3 domains: occupational activities, interpersonal relationships and independent living skills. There are 12 statements rated on a 7-point likert scale, from 0 = *extreme degree of change* to 6 = *no change.* The total score ranges from 0-72, with higher scores indicating better psychosocial functioning. The scale has good test-retest reliability (*r* = .90), inter-rater

reliability (r = .95) and internal consistency (α = .90). Construct validity is supported by significant correlations with scores on relevant subscales of the Sickness Impact Profile and KAS-relative Form 2. The SPRS-2 is also sensitive to outcomes measured using the Glasgow Outcome Scale, providing evidence of construct validity.

Analysis

Statistical analyses were conducted using IBM SPSS Statistics 22. Descriptive and frequency analyses were used to analyse sample demographics. Bivariate relationships were tested using Spearman's correlations as several questionnaires used ordinal metrics and because preliminary analyses identified non-normal distribution on some of the questionnaire measures and TASIT. One-tailed p values were chosen as specific directions were expected. False discovery rate was restricted to 0.05 using the Benjamini Hochberg method.

Results

Characteristics and internal consistency

Scores for the SSQ-TBI were normally distributed in the TBI population, ranging from 48 to 167 (*M* = 98.12, *SD* = 26.16). There was a significant difference in SSQ-TBI scores for those who attended the laboratory (n=24, *M* = 108.62, *S.D.* = 28.05) compared to those who did not (n=27, *M* = 90.77, *S.D.* = 22.40, $t(49) = -2.50$, $p<.05$). Internal consistency assessed using Cronbach's α was very good at .90 and no significant change to the overall α was observed with the deletion of any individual item.

Construct validity - Convergent

Questionnaires

As can be seen in Table 2, scores on the SSQ-TBI were correlated with informant questionnaires assessing various aspects of social and behavioural function. SSQ-TBI scores were moderately to strongly correlated with higher rates of informant reported dysexecutive behaviours on the CBS subscales, with frontal systems dysfunction measured using FrSBe, and with informant report of disinhibited behaviours on the NPI-D subscales. In contrast, relationships between SSQ-TBI and frontal systems dysfunction on the self-reported version of the FrSBe were not significant. However, although not significant when controlling for multiple comparisons, correlations approached significance for SSQ-TBI scores and self-reported FrSBe Disinhibition ($p = .04$) and Executive function ($p = .02$).

Neuropsychological tasks

In terms of social cognition, SSQ-TBI score did not correlate with emotion perception on TASIT 1 or ability to make social inferences on TASIT 2. While there was a trend toward higher SSQ-TBI scores being associated with poorer ability to make social inferences on TASIT 3, this was not significant when controlling for multiple comparisons ($p = .05$). SSQ-TBI scores were hypothesized to correlate with neuropsychological tasks assessing disinhibition, however relationships were not significant for performance on COWAT or Haylings tests.

Construct validity - divergent

As expected, SSQ-TBI score did not correlate with years of education or performance on a neuropsychological task of premorbid intellectual function.

Predictive validity

Moderate negative correlations were observed between the SSQ-TBI and occupation outcomes, interpersonal relationships and leisure/recreational activities assessed using the SPRS-2.

Discussion

Deficits in social functioning impact upon relationships, occupational and educational outcomes and quality of life following TBI. However, there are few tools available to assess social functioning following TBI, and the items in the tools that are available are not specific enough to be useful in determining specific aspects of social functioning that are impaired. The Social Performance Survey Schedule comprises a variety of items that tap various aspects of social functioning. However, the original version is very long (100 items) and many items are not relevant to persons with TBI. Thus, the SSQ-TBI was developed as a modified, shortened version of this scale. The findings of the present study provide preliminary evidence that the SSQ-TBI has sound psychometric properties in terms of internal consistency, convergent and divergent validity and predictive validity.

Overall, internal consistency, as assessed by Cronbach's α, was excellent at 0.90 and exceeds the value of 0.7 recommended by Nunnally [54] for instruments used for research and of at least .90 for instruments used in applied settings. This value is similar to values reported previously for other questionnaires that are used to assess behaviour following TBI such as the SPRS-2 [α = .90; 12], FrSBe [α = .92; 18], Behaviour Rating Scale of Executive Function – Adult [α = .80-.98; 55] and the Depression, Anxiety and Stress Scale [α = .84-.91; 56].

Convergent validity in the present study was assessed by measuring associations with other informant and self-report questionnaire measures of similar constructs, as well as a performance based measure of social skills and neuropsychological tasks of inhibition. Deficits in social skills following TBI often include poor ability to recognize and respond to emotional cues, emotional lability, lack of empathy, disinhibited behaviour, disinterest in others and lack of initiation. Such behaviours have been attributed to injury to the frontal lobes, therefore, it would be predicted that higher SSQ-TBI scores (indicating poorer social skills) should be associated with a higher frequency of behaviours related to frontal lobe functioning. Indeed, this was observed to be the case. Moderate to strong correlations were observed between the SSQ-TBI and informant report on questionnaires assessing frontal systems dysfunction, and including items related to apathy/loss of motivation, loss of emotional control, executive function and specifically, disinhibition.

Although strong correlations were observed between the SSQ-TBI and the above scales, this does not mean the SSQ-TBI is redundant. It is important that a comprehensive measure of social skills is available to characterize the social deficits of individuals with TBI. Such a scale would be useful for clinicians and researchers. While there would be expected strong relationships with similar constructs, the items of the SSQ-TBI identify specific behaviours that may be impacted by TBI and offer specific targets for rehabilitation.

In contrast, relationships were not significant between SSQ-TBI and the self-reported frontal systems dysfunction. This finding was not unexpected given that reduced insight is a common feature of TBI [57]. However, it should be noted that relationships between SSQ-TBI and self-reported disinhibition and executive dysfunction did approach significance but were not significant after controlling the false discovery rate, suggesting a trend toward insight into these specific difficulties and social skills deficits. In light of these findings, it would be of interest for future studies to consider how a self-report version compares to the informant report. A self-report version of the same scale may be of less use in characterizing social skills, but nevertheless, it can be beneficial for clinicians to be able to gauge degree of insight into social skills deficits in order to best develop plans and recommendations for how to address social skills. As such, we plan to investigate psychometric properties of a self-report version of the scale in future.

SSQ-TBI scores were not significantly related to performance on a standardized instrument measuring ability to read social cues presented using video vignettes (TASIT). This was contrary to hypotheses, as the test involves the ability to judge facial expressions and interpret sarcasm and lies, which are important aspects of everyday social interactions. However, previous studies have shown that informant report does not always correlate with objective measures, as the artificial testing environment is typically designed to elicit the participants' best performance [58]. The environment is usually quiet, free from distractions, requires completion of only one task at a time and provides one-on-one instruction. Thus, it may be the case that problems in social interactions are evident in particular settings that are not elicited by the formal testing context. Nevertheless, it is of interest that the relationship between SSQ-TBI scores and TASIT scores was in the expected direction for all three subscales. Further, the correlation between SSQ-TBI scores and the subscale of the TASIT examining enriched social inferences was approaching significance (p = .05). In light of this

trend, future examination of these relationships, perhaps with a larger sample size, would be of interest.

No significant relationship was obtained between the SSQ-TBI and neuropsychological measures of inhibition. This was contrary to our hypothesis that neuropsychological measures of disinhibition would predict disinhibition in a social context. Previous findings have been mixed in regard to this. McDonald and colleagues [40] found that disinhibition on cognitive tasks was associated with ability to inhibit emotions during an anger induction paradigm. Similarly, Tate [39] showed that disinhibition, operationalized using a rule-breaking variable, was associated with poorer emotional control. However, other studies have found no such relationship between social/emotional functioning and cognitive measures of response inhibition such as the Hayling and Brixton tests, Trail Making Test and COWAT [59, 60]. It is possible that although there is a theoretical link between social skills and cognitive disinhibition, this relationship requires a greater sample size to be significant. This is particularly likely to be the case since the SSQ-TBI assesses other aspects of social skills, not just social disinhibition. In studies with larger sample sizes it may be possible to examine whether there is a significant relationship between the items tapping social disinhibition specifically and cognitive disinhibition.

In terms of divergent validity, SSQ-TBI scores were not significantly associated with either years of education or premorbid intellectual functioning as assessed using a standardized reading task. This finding is important as it demonstrated that the scale is not simply a measure of intellectual ability. Further, this finding that social skills are distinct from intellectual function emphasizes the need for separate assessment of social function following TBI, as traditional neuropsychological testing tends to focus on cognitive abilities. Poor social behavior is a common consequence of TBI, presenting a barrier to maintaining relationships and return to work. Therefore, measures of social behavior should be incorporated into standard clinical practice.

In order to assess predictive validity, the association of the SSQ-TBI was compared to the SPRS-2, which provides broad information regarding psychosocial problems that are frequently encountered following TBI. As hypothesised, individuals with poorer social skills as measured using the SSQ-TBI endorsed more problems regarding occupational activities, interpersonal relationships and leisure activities. The pattern of correlations was also

sensible, with stronger relationships for the latter two subscales which are more directly related to social skills. The ability to return to work following TBI, on the other hand, can be impacted by other factors such as physical and cognitive disability, therefore it is not surprising that the relationship between the SSQ-TBI and this subscale is somewhat weaker.

There were several limitations for the present study. First, the current sample was predominantly male (80.39%). This is representative of the TBI population as a whole, but slightly lower than the reported prevalence in Australia of 70% males [61]. While the sample size of the current study was too low to examine each gender separately, it would be of interest in future studies to determine to what extent difficulties in social skills measured using the SSQ-TBI are observed in women with TBI.

Before the scale can be used by clinicians and researchers, further information would be required regarding its psychometric properties. Importantly, the test-retest reliability of the measure will need to be assessed. It would also be of interest to determine whether there are factors of interest that make up the scale. However, the sample size for the current study was not great enough to perform principle components analysis. As such, the current study provides only preliminary evidence for the usefulness of the SSQ-TBI in assessing social skills deficits following TBI. Nevertheless, this is an important first step in the development and publication of a much needed clinical and research tool.

Declaration of Interest

The authors report no conflicts of interest.

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Table 1: Demographic characteristics of participants

Characteristics	**Sample 1: Informant questionnaires only (n=27)**	**Sample 2: Participant with TBI attended lab (n=24)**
	M (S.D.)	**M (S.D.)**
Age	49.85 (13.60)	44.31 (14.51)
Education	13.48 (2.86)	12.17 (1.53)
Duration of PTA[a]	64.80(49.62)	77.40 (63.35)
Time since injury[b]	14.88 (11.32)	9.67 (8.59)
	n	**n**
Male	22	19
Female	5	5

Note. PTA=Post-traumatic amnesia.

[a] In days.

[b] In years.

Table 2. Spearman's rank correlations between SSQ-TBI informant report scores and questionnaires, objective measures and neuropsychological tasks aimed at providing evidence of convergent, divergent and predictive validity.

Measure	***r***		***p***	
Convergent validity				
Emotion dysregulation (CBS)				
Emotional control	0.50		.000	
Motivation	0.39		.003	
Frontal systems dysfunction (FrSBe)	FR	SR	FR	SR
Total	0.84	0.30	.000	.072
Apathy	0.64	0.07	.002	.374
Disinhibition	0.84	0.35	.000	.041
Executive Function	0.75	0.41	.000	.021
Disinhibited behaviours (NPI-D)				
Frequency	0.50		.000	
Severity	0.52		.000	
Level of distress	0.63		.000	
Social Inference (TASIT)*				
TASIT 1: Emotion recognition	0.24		.111	
TASIT 2: Social Inference – Minimal	0.26		.096	
TASIT 3: Social Inference - Enriched	0.32		.053	
Disinhibition				
COWAT errors*	0.16		.225	
Haylings Test*	0.13		.257	
Divergent validity				
Intellectual abilities				
Years of education	-0.05		.358	
Wechsler Test of Adult Reading*	-0.16		.363	
Predictive validity				
Psychosocial Outcomes (SPRS-2)	-0.38		.003	
Occupational outcomes	-0.69		.000	
Interpersonal Relationships	-0.57		.000	
Leisure/Recreational activities				

Note: FR= Family report, SR=Self-report *=completed only by individuals who attended the laboratory (n=24). CBS = Current Behavior Scale; FrSBe = Frontal Systems Behavior Scale; NPI-D = Neuropsychiatric Inventory Disinhibition subscale; TASIT = The Awareness of Social Inference Test; COWAT = Controlled Oral Word Association Test; SPRS-2 = Sydney Psychosocial Reintegration Scale 2