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Investigating the Discrepancy Between Subjective and Objective Cognitive Impairment Following Acquired Brain Injury: The Role of Psychological Affect

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Key words: Brain injury; cognitive impairment; self-rating; anxiety; affect.

BACKGROUND: Previous research examining the use of self-reported cognitive impairment as a reliable predictor of actual objective cognitive impairment (OCI) has provided mixed results.

OBJECTIVE: The current study aimed to examine the potential discrepancy between subjective and objective cognitive impairment in a sample of individuals with an acquired brain injury (ABI).

METHOD: Twenty-four participants, recruited from a community brain injury service, completed an objective neuropsychological assessment and a series of self-report questionnaires assessing psychological affect and perceived cognitive difficulties.

RESULTS: Correlational analyses revealed no association between objective cognitive impairment and self reported subjective cognitive impairment. Conversely, psychological affect, such as anxiety and depression, was found to be highly correlated with subjective cognitive impairment. A hierarchical regression analysis revealed psychological affect as a significant predictor of subjective cognitive impairment. Objectively measured cognitive impairment was found to be non-significant.

CONCLUSIONS: These findings suggest that an individual's subjective experience of their cognitive difficulties following ABI are not associated with their actual objective cognitive impairment. Clinicians may benefit from considering other possible psychological factors that may play a more crucial role in a patient's appraisals of their cognitive impairments.

1. Introduction

Acquired Brain Injury (ABI), defined as cerebral damage occurring after birth and not a result of congenital or progressive disease, has been shown to result in a wide variety of both physical and psychological difficulties. Difficulties with mood and anxiety are a common experience for individuals following an ABI (Gracey, 2002). Prevalence rates reaching 61% have been demonstrated for depression (Kim *et al.* 2007), and up to 70% for anxiety (Rao & Lyketsos, 2002). In addition to negative affect, impairments in cognitive functioning are also a frequently reported and challenging difficulty for those with ABI (Whyte *et al.* 2011).

Whilst Magnetic Resonance Imaging (MRI) can reveal potential structural issues within the brain, it cannot provide more in-depth knowledge of cognitive functioning. For these data, we rely upon subjective and objective methods of neuropsychological assessments to investigate the extent and nature of the cognitive impairment. Due to time constraints, and the practical requirements of objective neuropsychological testing, it is often an individuals' subjective self-report of their cognitive impairment that is used to screen for further assessment or treatment decisions. However, previous research examining the use of self-report as a reliable predictor of actual objective cognitive impairment (OCI) has provided mixed results. Longitudinal studies by Hohman, Beason-Held, Lamar & Resnick (2011) and Dufouil, Fuhrer, & Alperovitch, (2005) have offered support for the validity of subjectively reported cognitive impairment (SCI) as a reliable indicator of OCI in both clinical and non-clinical populations. However, significant discrepancies between SCI and OCI have been demonstrated in various populations, including those with; multiple sclerosis (Middleton, Denney, Lynch & Parmenter, 2006), schizophrenia (Homayoun, Nadeau-Marcotte, Luck, & Stip, 2011), insomnia (Orff, Drummond, Nowakowski, & Perils, 2007) and gulf war veterans (Spencer, Drag, Walker, & Bieliaskas, 2010). The direction of the discrepancy between SCI and OCI observed in previous literature indicates that individuals often over report their cognitive difficulties, even in absence of any actual objective cognitive impairment (French, Lange & Brickell, 2014;

Middleton *et al.* 2006). However, divergent directions of discrepancy between SCI and OCI have also been observed in individuals with different severities of ABI. Jamora, Young & Ruff (2012) found that those with Mild TBI were more likely to over report their cognitive symptoms in comparison to those with moderate to severe TBI. Conversely, levels of SCI, as measured by the Ruff Neurobehavioral Inventory (RNBI), reported in those with moderate to severe TBI was more consistent with objective cognitive assessments. Jamora *et al.* (2012) also highlighted that the Mild TBI group demonstrated higher rates of post-traumatic stress disorder (PTSD), and concluded that this may have had a cumulative effect on high levels of reported SCI.

Neurobiological changes alone do not explain the heterogeneous expression of emotional and behavioural difficulties following an ABI. For this reason, conceptual models have highlighted the importance of the interaction between biological, environmental and psychological factors (Warriner & Velikonja, 2006). Psychological factors such as an individual's personality, premorbid coping style and preexisting psychological difficulties are thought to be crucially important in the manifestation of neurobehavioural and emotional difficulties following ABI (Warriner & Velikonja, 2006). Subsequently, it is not unreasonable to suggest that psychological factors may also play a mediating role in the level of reported SCI.

Empirical evidence has demonstrated that a large proportion of variance in broader post-ABI cognitive symptoms (i.e. poor concentration, forgetfulness, insomnia, decreased coordination) have been accounted for by factors other than actual injury severity (Stulemeijer, Vos, Bleijenberg & Van der Werf, 2007; Chamelian & Feinstein, 2006; Trahan, Ross & Trahan, 2001). Trahan, Ross & Trahan (2001) found a strong positive correlation (r= 0.68) between scores on the Beaumont Postconcussional Index (BPCI) and the Beck Depression Inventory (BDI-II). A significant positive correlation (r= 0.64) was also demonstrated between the BCPI and anxiety, as measured by the Beck Anxiety Inventory. Spencer *et al*. (2010) provided further support finding positive correlations between self-reported ratings of cognitive function, as measured through a

standardized military questionnaire, and psychological affect. Furthermore, an additional post hoc analysis revealed that anxiety, above several other psychological symptoms (such as post traumatic stress disorder and depression), to be the main mediating variable predicting SCI. More recently, French, Lange & Brickell (2014) replicated the strong associations between SCI, as measured by the Neurobehavioral Symptom Inventory (NSI), and psychological affect demonstrated in previous studies. Furthermore, French et al. (2014) completed an additional analysis investigating the relationship between SCI and performance on objective neuropsychological assessment, which revealed no significant correlation.

The additional analysis by French *et al.* (2014) again highlights the frequent discrepancy observed between SCI and OCI in an ABI population. However, it should be noted that both Spencer *et al.* (2010) and French *et al.* (2014) used samples from a military population, adding to the many confounding variables that are already present in such a heterogeneous population. It was highlighted that factors such as litigation and the prospect of medical discharge should be considered when interpreting these results. Therefore, further studies from non-military populations may prove beneficial in generalizing the above findings to civilian clinical settings. Empirical evidence from non-military populations is now becoming more established. Lamb *et al.* (2013) recently examined the impact of negative affect, fatigue and OCI as potential predictors of SCI, as measured by the A-B Neuropsychological Assessment Schedule, in 25 older adults following ischemic stroke. The overall statistical model, which included all three predictor variables (depression, fatigue and OCI), accounted for 61% of the total variance of SCI. However, depression was the only variable found to significantly predict SCI.

Investigating potential psychological factors that play an influential role in SCI may help to provide clinicians with a broader knowledge and understanding to address the underlying processes mediating high SCI in the absence of OCI. Identification of these key factors may be beneficial at both the screening and rehabilitation stage of a patient's care. For instance, should anxiety play a

significant role in SCI, clinicians may work within a more evidenced-based psychological paradigm (e.g. CBT) to reduce anxiety, which may in turn reduce SCI, as opposed to using cognitive rehabilitation strategies in the first instance. In addition, establishing the nature of anxiety may also prove beneficial in this population. For example, health anxiety, as opposed to generalised anxiety, may play a more prominent role in increased levels of SCI. This pattern has been established across a wide range of physical health disorders (Bryan, 2011).

The aim of the current study is to examine the potential discrepancy between SCI and OCI, and to determine what role psychological factors play in SCI. Grounded on the existing empirical data the current study makes the following hypotheses:

H0: There will be no significant correlation between OCI and SCI.

H1: Levels of anxiety will be positively correlated with SCI.

H2: Levels of depression will be positively correlated with SCI

H3: Levels of Health Anxiety will be positively correlated with SCI

2. Method

2.1. Participants

The participant sample consisted of 24 individuals with various aetiologies of ABI. All participants were aged between 36 and 72 years and were receiving ongoing support from a National Health Service community brain injury service based in a rural part of the United Kingdom. The level of support each participant received from the service was based on individual need. All participants were considered medically stable and were referred to the service due to cognitive, emotional or physical difficulties as a result of their ABI. The date of injury ranged from 8 months to 17 years. Further demographic information is outlined in *Table 1*.

----------Insert table 1----------

Diagnoses of ABI were confirmed through clinical imaging (e.g. MRI or computerized tomography) and neurological examination. The nature and severity of the ABI was determined in accordance with Malec *et al.* (2007) through retrospective examination of medical notes, which included scan reports, Glasgow Coma Scale (GCS) scores, Post-Traumatic Amnesia (PTA) and period of loss of consciousness where available. The nature of the injuries can be separated into three categories: 'Traumatic Brain Injury (TBI)', 'Cerebral Vascular Accident (CVA)' and 'Other'. Participants with TBI could be further separated into three classifications of TBI: Mild (n = 1), Moderate (n = 1) and severe (n = 9). A third aetiological category was developed (Other), as the nature of injury for two participants did not meet criteria for TBI or CVA: one participant acquired their brain injury through infection, and the other through a brain tumor.

In order to control for confounding variables exclusion criteria were employed. Participants were excluded from the study if they had ongoing difficulties with drug and alcohol abuse, a co-morbid neurodegenerative disease or a previous diagnosis of intellectual disability.

2.2. Measures

2.2.1 Objective Measure of Cognitive Impairment

Objective cognitive impairment was measured using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998). Although originally developed for the neuropsychological assessment of dementia in older adults, the RBANS has shown internal validity, ecological validity and test-retest reliability for the assessment of cognitive impairment in those with TBI (McKay, Casey, Wertheimer & Fichtenberg, 2007), CVA (Larson *et al.* 2005) and Concussion (Moser & Schatz, 2002). The RBANS comprises of 12 subtests, providing a composite score for 5 cognitive domains: Immediate

Memory, Visuospatial/Constructional, Language, Attention and Delayed memory. A total scale score is also provided, which provides a general measure of cognitive functioning. Comparable to the WAIS-IV, scores on the RBANS can be translated into standardised scores with a mean of 100 and a standard deviation of 15. Subsequently, standardised scale scores of 70 or below would imply a "borderline to low range" performance equal to, or lower than, the second percentile of age matched peers.

2.2.2. Measure of subjective cognitive impairment

The Cognitive Failures Questionnaire (CFQ; Broadbent *et al*., 1982) was used as a self-report measure of SCI. The CFQ is a 25-item questionnaire examining self-reported everyday lapses in cognitive functioning (e.g. Do you forget where you put something like a newspaper or a book?). The CFQ has demonstrated excellent reliability and internal consistency in a healthy student population (Cronbach's $\alpha = 0.90$; Bruce, Ray & Carlson, 2007).

Although the CFQ was initially developed to provide a general SCI score, recent factor analyses have revealed multiple subscales, which offer further exploration of SCI domains (Attention, Memory and Motor Function; Payne, & Schnapp, 2014). Items are rated on a five-point Likert scale ranging from 0 (never) to 4 (very often). Total CFQ scores range from 0 to 100, with higher scores reflecting higher levels of SCI.

2.2.3. Measures of Psychological Affect

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used as a measure of depression and anxiety. The HADS is a 14-item scale, with 7 items measuring anxiety and 7 items measuring depression. Items are rated on a 4-point Likert Scale, with higher scores reflecting higher levels of depression and anxiety. Subscale scores between 0 – 7 are considered to be 'normal', 8 – 10 'borderline', and 11 – 21 are within the 'abnormal/clinical' range. The HADS has been found to be a valid and reliable scale for the psychometric assessment of

anxiety (Cronbach's α from .68 to.93, mean α=.83) and depression (Cronbach's α from .67 to.90, mean α=.82) in a variety of populations (Bjelland, Dahl, Haug & Neckelmann, 2002), including ABI (Whelan-Goodinson, Ponsford, & Schönberger, 2009).

In addition to a general measure of anxiety, a specific measure of health anxiety was used to examine whether health anxiety symptoms have a lesser or greater effect on SCI. The Health Anxiety Inventory (HAI-18; Salkovskis, Rimes, Warwick, & Clark, 2002) was used to measure levels of health anxiety. The HAI-18 is an 18-item self-reported questionnaire, which measures cognitive factors associated with health anxiety (Salkovskis *et al*. 2002). Items on the HAI-18 are rated on a 4-point Likert Scale with higher scores reflecting higher levels of health anxiety. Previous literature has found mean scores of 37.9 (±6.8) to reflect populations with clinical levels of health anxiety (Salkovskis *et al*. 2002). The HAI-18 has been shown to be a valid and reliable scale (r = 0.90) for the assessment of health anxiety (Salkovskis *et al*. 2002), independent of physical health status (Abramowitz, Deacon & Valentiner, 2007).

2.3. Procedure

Ethical approval was sought from the National Health Service Research Ethics Committee (NHS REC) and The School of Psychology, at Bangor University. Following ethical approval, potential participants who met the inclusion criteria were identified and approached by their lead clinician within the community brain injury service to determine their potential interest in participating in the current study. Following an expression of interest, the principal researcher contacted the participant to arrange a suitable time and date to complete the psychological questionnaires and neuropsychological assessment. The neuropsychological assessment was completed in clinic rooms local to the participant or in their own home. To control for potential confounding environmental factors, the administration of the assessment was completed in a quiet environment with little distractions. All questionnaires were self-

administered by the participants under the supervision of the researcher. The duration of the assessment ranged between 60 to 90 minutes.

2.4. Statistical Analysis

The statistical software package IBM SPSS version 22 (IBM Corp, 2012) was used to perform the statistical analyses. A Shapiro-Wilks test of normality was initially completed to further examine if the data met parametric assumptions. An independent samples *t*-test was initially completed to test for any statistically significant differences between the CVA and TBI aetiology groups on measures of anxiety, depression, SCI and OCI. As the third group ('Other') consisted of only two participants, it was not deemed meaningful to complete an ANOVA to examine differences between all three groups.

A second analysis, using Pearson's correlation coefficients, was completed to examine potential relationships between OCI, SCI and psychological variables. As there was no significant difference between CVA and TBI groups, the correlational analysis was completed for the whole participant sample (n=24). Following examination of the correlation coefficients, a 'post hoc' analysis using Stieger's (1980) equations was completed to determine whether the correlation between SCI and anxiety was significantly larger than the correlation between SCI and depression.

Finally, a three stage hierarchical regression analysis, with SCI as the dependent variable, was completed in order to identify the main predictors of SCI. Demographic variables were entered at stage one (Model 1) of the regression in order to control for demographic factors such as age, type of injury, educational history, gender and time since injury. Objective impairment, as measured by total RBANS score, was entered at stage two (model 2). Psychological factors such as health anxiety, anxiety and depression were entered at stage three of the model (model 3).

3. Results

The mean score for depression and anxiety measures lay within the 'normal' to 'borderline' range. However, five participants within the sample possessed scores that met the clinical threshold for depression. Eight participants also reached clinical ranges for anxiety. All health anxiety scores fell below the clinical threshold (Salkovskis *et al*. 2002). An independent samples *t*-test revealed no statistically significant differences ($p < 0.05$) between CVA and TBI groups across all measures of cognitive impairment (SCI and OCI) and psychological factors (Health Anxiety, Anxiety and Depression). The descriptive and inferential statistics for all measures are outlined in *Table 2.*

----------Insert Table 2 ----------

As expected, the RBANS subtests (Immediate Memory, Attention and Delayed Memory) were all reciprocally correlated (r= .48 to .79, p<0.05). This is likely due to the high internal consistency of the neuropsychological assessment (McKay *et al.,* 2007). Similarly, CFQ subscales measuring SCI in Attention, Memory and Motor function were also highly correlated (r= .83 to .96, p<0.05). However, no statistically significant relationship between CFQ subscales and RBANS subtest scores (r= .01 to .28, p>0.05) were revealed. The relationship between the 'RBANS Total score' and 'CFQ Total score' was found to be non-significant (r_{22} = -.096, p = .656), therefore supporting the null hypothesis (H0). The results of the correlational analysis are summarized in *Table 3*.

----------Insert Table 3 ----------

3.1. Psychological factors

In support of hypotheses 1 and 2 (H1 & H2), the correlation analysis indicated that participants who reported higher levels of anxiety and depression demonstrated higher levels of SCI (see *figure 1 & 2*). Large positive correlations

were found between scores on the HADS Anxiety Scale and all CFQ measures: CFQ total score (r_{22}= .821, p<.000), CFQ Memory (r_{22}= .810, p<.000), CFQ Attention (r_{22}= .749, p<000), and CFQ Motor Function, (r_{22}= .832, p<000). Likewise, scores on the HADS Depression scale significantly correlated with total CFQ scores, (r_{22}= .505, p= .012), CFQ Attention subtest, (r_{22}= .518, p= .010), CFQ Motor function subtest (r_{22}= .509, p= .011), and RBANS Immediate memory score (r_{22}= .457, p= .025). A strong positive correlation was found between health anxiety and depression (r_{22}= .600, p= .002). No other significant correlations were demonstrated between psychological variables. Health Anxiety, as measured by the HAI-18, did not show any statistically significant correlation with measures of SCI or OCI, therefore hypothesis 4 was not supported.

----------Insert Figure 1 and Figure 2 ----------

The strength of the correlation between anxiety and SCI (r_{22}= .821) was notably larger than the correlation between depression and SCI (r_{22}= .505). A post hoc analysis, using Stieger's (1980) equations, revealed that the observed difference between the two correlations was statistically significant (z=2.17, p=0.016).

3.2. Hierarchical regression analysis

The regression analysis revealed that demographic variables did not significantly contribution to the regression model ($F_{(6,17)}$ = .933, p= .497), accounting for only 1.8% of the variance in SCI. Furthermore, the introduction of OCI at stage 2 (model 2) was also shown to be non-significant ($F_{(7,16)}$ = .767, p= .622), explaining 7.6% of variation in SCI. However, the introduction of psychological variables at stage three (model 3) were found to significantly increase the variance of the model to 81% ($F_{(10,13)}$ = 10.55, p= .000). Further examination of the psychological variables revealed that anxiety ($t_{(23)}$=5.24, p<.000) was the most significant predictor of SCI, followed by depression ($t_{(23)}$=3.78, p= .002). Health anxiety was found to be non-significant ($t_{(23)}$=-1.95, p=.074).

----------Insert Table 4 ----------

4. Discussion

The use of the RBANS to measure OCI allowed the assessment of specific cognitive domains (immediate memory, delayed memory, attention) in addition to 'total cognitive impairment' (total RBANS score). Similarly, as previous factor analyses (Payne, & Schnapp, 2014) of the CFQ have revealed specific SCI domains, the current study was able to measure specific self-reported impairments in attention, motor function and memory. Further analysis of the relationship between specific OCI and SCI domains revealed no significant interaction. Therefore, specific self reported complaints in memory and attention did not correspond with objective measurement of these cognitive domains. Equally, overall SCI, as measured by the total CFQ score, demonstrated no association with total OCI (r = -.096). These finding are in line with previous research that have observed similar discrepancies between OCI and SCI in those with multiple sclerosis (Middleton, Denney, Lynch & Parmenter, 2006), schizophrenia (Homayoun, Nadeau-Marcotte, Luck, & Stip, 2011), and gulf war veterans with TBI (Spencer, Drag, Walker, & Bieliaskas, 2010).

Conversely, measures of psychological affect were found to significantly correlate with SCI. Depression demonstrated large positive correlations with two out of three SCI domains (attention and motor function), in addition to total SCI. The key finding was that anxiety demonstrated the largest correlation across all SCI domains; the most notable being between anxiety and total SCI (*r*= .821). Subsequently, individuals with higher levels of anxiety may be more likely to report higher rates of SCI. The post hoc analysis revealed that the correlation between anxiety and SCI was significantly larger than the correlation between depression and SCI. This suggests that anxiety may play a more crucial role in SCI when compared to other psychological affect such as depression. This suggestion was further supported by the results of the hierarchical regression analysis. The regression analysis allowed the identification of key psychological variables that contribute to the prediction of SCI after the variance of OCI and demographic

factors have been controlled (i.e. entered in to the preceding steps). At the first step of the model, demographic factors such as time since injury, age, gender and years of education were found to be non-significant in the prediction of SCI. Similarly, the inclusion of OCI at the second step was also found to be non-significant. However, the inclusion of the psychological variables at the third step of the hierarchy was found to make a significant contribution to the model. Further examination of the model revealed anxiety to be the main variable of interest in the prediction SCI, followed by depression. Health anxiety did not significantly contribute to the model suggesting that general anxiety symptoms, rather than a specific health anxiety, may be more relevant for this population.

The results of the current study are consistent with the emerging ABI evidence base, which have also found discrepancies between OCI and SCI (Spencer *et al*., 2010; Lamb *et al.,* 2013). However, it should be noted that the findings from Lamb *et al.* (2013) somewhat differ from the current study. Lamb *et al.* (2013) found depression to be the main psychological variable to play a contributing role in the prediction of SCI. This incongruence between findings may be due to the small sample sizes used in both studies.

With the exception of Health Anxiety and Depression, no other correlations between psychological factors were found to be significant. This finding is inconsistent with previous literature (Bjelland, *et al*., 2002), which has demonstrated large correlations between the two HADS subscales (HADS-A and HADS-D, r = 0.80). Similarly, there was a small and non-significant correlation between the HAI and HADS-A subscale. The lack of correlations between psychological factors may again be attributed to a type-II error. However, the content of the HAI and the HADS are intrinsically different, which may also explain the lack of correlation between the two measures. The HAI predominately focuses on somatic symptoms related to health, whereas the HADS predominately focuses on general anxiety symptoms.

It is plausible that low mood and anxiety may be a normal reaction to a perceived impairment of ones' own cognitive ability. However, evidence from the health

psychology literature indicates an opposite notion, in that those with high negative affect are more sensitive to subjective physical discomfort – '*the symptom perception hypothesis*' (Watson & Pennebaker, 1989). With this, could the *symptom perception hypothesis* be extended from the physical to the cognitive? Empirical studies using non-clinical populations have found that negative affect, particularly anxiety, negatively influences subjective appraisal of memory in absence of any objective impairment (Dux *et al.* 2008). Further studies, which adopt a more controlled experimental design, may offer benefit in investigating the impact of treating negative affect on reducing the level of SCI in those following ABI.

Additionally, as the sample consisted of a mixture of ABI aetiologies, an analysis to examine for differences between aetiology types was completed. In contrast to previous findings (Tateno, Murata & Robertson, 2002), the current study did not reveal any differences between CVA and TBI aetiology on measures of OCI, SCI or measures of psychological affect. It should be noted that there was a wide range of time since injury (8 months to 10+ years) between all participants, which may explain the lack of statistical difference between aetiologies on all outcomes.

Limitations

The study did not collect any information regarding the litigation status of the participants. The impact of litigation on cognitive and psychosocial outcomes has been well documented in previous studies (Wood & Rutterford, 2006). Furthermore, the study did not employ any assessment of effort. This may be considered a potential limitation. Employing tests of effort would have helped to control for confounding variables such as the potential for deceit.

It should also be noted that the current study's sample did not reach the recommended minimum sample size of 42, as indicated by the power analysis (parameters: ß=0.80, alpha = 0.05, anticipated effect = 0.6). The modest sample size in the current study may have impeded the detection of all but the largest associations between variables (Type II error). Further research using larger

sample sizes may prove to be beneficial by offering more clarity on the key psychological factors, and provide more power to detect weaker associations between variables.

The psychological measures adopted in the current study (HAI, HADS & CFQ) have not been psychometrically evaluated in an ABI population. As such, the reliability and validity of the measures are based on other clinical samples. In addition, exploratory factor analyses of the questionnaires have not been completed. It is possible that alternative factor structures may emerge when using an ABI population. The use of the RBANS may also be considered as a potential limitation. Although the RBANS is considered a comprehensive screening tool to measure cognitive impairment in those with ABI (McKay *et al*. 2007), it may lack sensitivity when compared to more thorough assessment tools, such as the WAIS-IV. However, the RBANS has demonstrated superior sensitivity when compared to other commonly used screening tools such as the Mini Mental Status Examination (MMSE) and the Neurocognitive Status Examination (COGNISTAT) (McKay *et al*. 2007; Carone, Burns, Gold, Mittenberg, 2004).

The cross-section correlational design of the study may be considered as a further limitation. The findings of the current study may reflect previously demonstrated associations between psychological difficulties and cognitive symptoms, such as poor concentration and memory (Gould, Ponsford, & Spitz, 2014). Although the design allowed the examination of associations between variables, it did not reveal the directions of causality or the temporal relationships.

Due to the population under investigation, it would be imprudent to ignore the importance of insight and self-awareness of cognitive impairment. Individuals with an ABI display a wide range of awareness problems in relation to their physical, social and cognitive ability (Prigatono & Schacter, 1991). Furthermore, lack of awareness for cognitive impairment has been shown to be more prominent when compared to awareness for physical impairment (Sherer *et al.*

2003). The discrepancy between SCI and OCI likely reflects an individuals' insight into their current cognitive impairment. However, as the current study did not employ a standardized measure of insight, a test of association could not be performed. Future studies may benefit from adopting a more standardized measure of insight when examining the discrepancy between objective and subjective cognitive impairment.

Conclusion

In conclusion, the results of this study may have important implications for clinical practice. Firstly, actual objective cognitive performance on neuropsychological assessments should not be automatically interpreted as a reliable indicator of one's subjective experience of their cognitive difficulties. Clinicians should consider possible psychological factors that may play a more crucial role in patient's appraisals of their cognitive impairments. Consequently, a thorough assessment of mood and anxiety should be carried out and considered in response to self reported SCI. Clinicians may also consider psychological interventions as the primary rehabilitation strategy to address negative affect in those who report high SCI in absence of any objective impairment, instead of cognitive rehabilitation interventions. For example, treating mood and anxiety difficulties, using evidence based therapeutic models, may prove beneficial prior to administering cognitive assessments. In addition, Psychoeducation Groups may benefit from incorporating information regarding the discrepancy between OCI and SCI. Furthermore, the *symptom perception hypothesis* may be generalized from the physical to the cognitive, highlighting how psychological mechanisms, such as hypervigilance, attentional and attribution biases may explain high SCI, in absence of actual OCI.

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None

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Table 1. *Demographic characteristics of participants*

	All Participants	CVA	TBI	Other
Number of participants	24	13	9	2
Age *(M, [S.D])*	56.3 (8.37)	56.6 (7.33)	58.9 (7.27)	42.0 (8.48)
Gender (N, %)				
Male	18 (75%)	10 (76.9%)	7 (77.8%)	1 (50%)
Female	6 (25%)	3 (23.1%)	2 (22.2%)	1 (50%)
Time since injury (N, %)				
8 months – 2 years	6 (25%)	4 (30%)	2 (22.2%)	0
2 – 4 years	6 (25%)	5 (38.5%)	0	1 (50%)
4 – 6 years	3 (12.5%)	2 (15.4%)	1 (11.1%)	0
6 – 10 years	4 (16.7%)	1 (7.7%)	3 (33.3%)	0
10+ years	5 (20.8%)	1 (7.7%)	3 (33.3%)	1 (50%)
Education (N, %)				
<12 years	9 (37.5%)	6 (42.2%)	2 (22.2%)	1 (50%)
12 – 14 years	6 (25%)	2 (15.4%)	3 (33.3%)	1 (50%)
14 – 17 years	8 (33.3%)	5 (38.5%)	3 (33.3%)	0
17+ years	1 (4.2%)	0	1 (11.1%)	0

Table 2. *Results of t-test for aetiological differences and descriptive statistics for psychological factors, subjective and objective cognitive impairment.*

Measure	All Participants			Type of Injury									t-test of statistical difference between CVA and TBI		
				CVA			TBI			Other					
	n	M	S.D.	n	M	S.D.	n	M	S.D.	n	M	S.D.	95% CI for mean Difference	t	df
Objective Impairment															
Immediate Memory	24	74.54	20.85	13	76.69	20.48	9	72.89	23.31	2	68.00	21.21	-15.78, 23.39	.41	20
Visuospatial/ Constructional	24	89.96	17.44	13	84.69	13.27	9	98.44	17.56	2	86.00	36.77	-27.48, -0.02	-2.09	20
Language	24	88.42	14.56	13	90.77	13.66	9	86.67	17.06	2	81.00	9.90	-9.56, 17.73	.62	20
Attention	24	80.75	19.73	13	77.92	16.74	9	87.56	20.82	2	68.50	36.06	-26.34, 7.08	-1.20	20
Delayed Memory	24	78.00	19.51	13	71.92	20.31	9	85.33	17.80	2	84.50	14.85	-30.90, 4.08	-1.60	20
Total Score	24	77.42	15.37	13	74.92	12.80	9	82.11	17.25	2	72.50	27.58	-20.52, 6.14	-1.12	20
Subjective Impairment															
Memory	24	15.39	8.07	13	14.31	5.53	9	17.00	10.32	2	15.00	15.55	-9.75, 4.34	-.80	20
Attention	24	20.38	8.70	13	19.38	7.24	9	22.56	10.21	2	17.00	14.14	-10.90, 4.56	-.86	20
Motor Function	24	13.62	7.54	13	12.61	6.31	9	14.44	9.00	2	16.50	12.02	-8.62, 4.96	-.56	20
Total CFQ Score	24	53.79	24.42	13	50.85	18.83	9	58.22	30.36	2	53.00	42.42	-29.18, 14,44	-.71	20
Psychological Factors															
HAI	24	17.37	9.10	13	16.46	8.14	9	20.56	10.41	2	9	0	-12.24, 4.15	-1.04	20
HADS Anxiety	24	8.62	5.05	13	8.62	3.52	9	9.11	6.77	2	6.5	7.78	-5.09, 4.10	-.23	20
HADS Depression	24	6.88	4.15	13	5.84	2.41	9	8.56	5.90	2	6.00	2.83	-6.48, 1.06	-1.50	20

Note: CVA = Cerebral Vascular Accident; TBI = Traumatic Brain Injury; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; CFQ = Cognitive Failures Questionnaire, HAI = Health Anxiety Index, HADS = Hospital Anxiety and Depression Scale; CI = Confidence Intervals.

*p = <0.05. **p = <0.01.

Table 3. *Pearson correlation coefficients of key variables*

	Objective Impairment (RBANS)				Subjective Impairment (CFQ)				Psychological Factors		
	Immediate Memory	Attention	Delayed Memory	Total Score	Memory	Attention	Motor function	Total CFQ	Health Anxiety	Anxiety	Depression
Objective Impairment											
Immediate Memory	1	.488*	.526**	.792**	.099	.118	.014	.104	.325	-.111	.457*
Attention	.488*	1	.492*	.736**	-.309	-.160	-.286	-.224	.215	-.473*	.253
Delayed Memory	.526**	.492*	1	.757**	-.168	-.077	-.067	-.098	.179	-.163	.279
Total Score	.792**	.736**	.757**	1	-.129	-.028	-.198	-.096	.190	-.373	.306
Subjective Impairment											
Memory	.099	-.309	-.168	-.129	1	.898**	.870**	.958**	.195	.810**	.385
Attention	.118	-.160	-.077	-.028	.963**	1	.837**	.963**	.366	.749**	.518**
Motor function	.014	-.286	-.067	-.198	.870**	.837**	1	.934**	.205	.832**	.509*
Total CFQ	.104	-.224	-.098	-.096	.958**	.963**	.934**	1	.276	.821**	.505*
Psychological Factors											
HAI	.325	.215	.179	.190	.195	.366	.205	.276	1	.307	.600**
HADS Anxiety	-.111	-.473*	-.163	-.373	.810**	.749**	.832**	.821**	.307	1	.281
HADS Depression	.457*	.253	.279	.303	.385	.518**	.509*	.505*	.600**	.281	1

Note: RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; CFQ = Cognitive Failures Questionnaire, HAI = Health Anxiety Index, HADS = Hospital Anxiety and Depression Scale.

*p = < 0.05, **p = < 0.01.

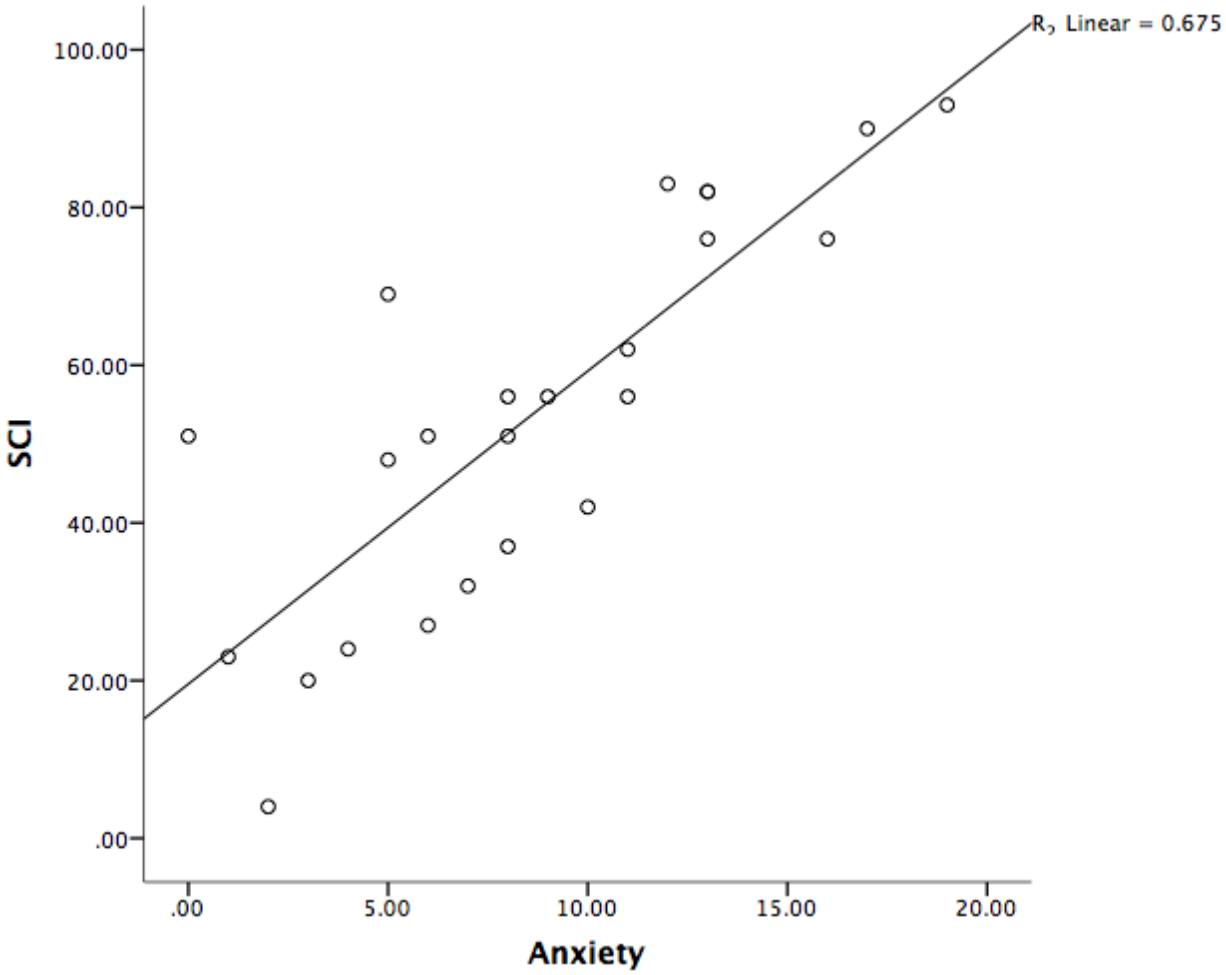

Figure 1. *Scatter plot demonstrating the positive relationship between Anxiety and SCI*

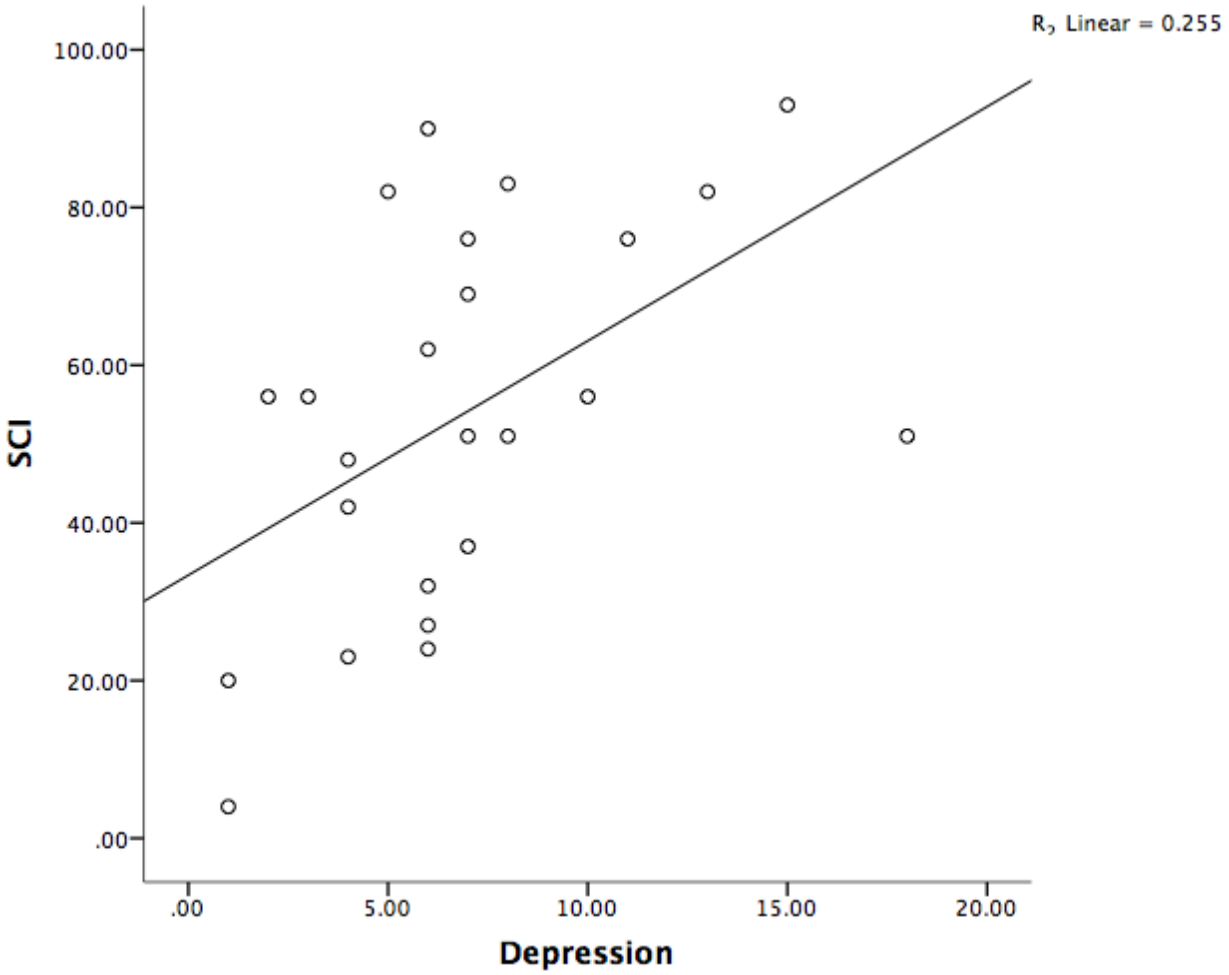

Figure 2. *Scatter plot demonstrating the positive relationship between Depression and SCI*

Table 4. *Summary of Hierarchical regression analysis for predictors of SCI*

	Model 1 (Demographics)			Model 2 (Objective Cognitive Impairment)			Model 3 (Psychological Factors)		
Variable	*B*	*SE b*	*β*	*B*	*SEB*	*β*	*B*	*SEB*	*β*
Type of Injury									
CVA (Constant)	44.35	45.78	-	41.22	48.38	-	11.47	21.99	-
TBI	.29	12.16	.01	-.49	12.81	-.01	-5.53	5.79	-.11
Other	-15.60	22.12	-.18	-17.49	23.73	-.20	-10.47	11.00	-.12
Age	-.39	.74	-.13	-.49	.84	-.17	-.48	.36	-.16
Gender	13.12	11.94	.24	13.31	12.30	.24	-.53	5.52	-.01
Time since injury	6.34	3.79	.40	6.68	4.03	.42	4.32	1.96	.27
Years of Education	-.96	5,72	-.04	-1.57	6.27	-.06	-7.25	3.01	-.28
RBANS Total Score	-	-	-	.12	.44	.08	.45	.20	.28
Anxiety	-	-	-	-	-	-	3.36	.64	.69**
Depression	-	-	-	-	-	-	3.33	.88	.57**
Health Anxiety	-	-	-	-	-	-	-.66	.34	-.25
Adjusted R^2		-.018			-.076			.81**	
R^2 Change		.248			.004			.64**	
F		.933			.767			10.55**	

Note: Type of Injury was represented as three dummy variables with CVA serving as the reference group (Constant)
**p = <0.01.