HHS Public Access
Author manuscript
Rehabil Psychol. Author manuscript; available in PMC 2022 December 07.

Published in final edited form as:
Rehabil Psychol. 2013 November ; 58(4): 429–435. doi:10.1037/a0034554.

Anxiety as a Primary Predictor of Functional Impairment After Acquired Brain Injury: A Brief Report

Hilary C. Bertisch,
Coralynn Long,
Donna M. Langenbahn,
Joseph F. Rath,
Leonard Diller,
Teresa Ashman
Rusk Institute of Rehabilitation Medicine, New York University School of Medicine

Abstract

Objective: Cognitive and emotional symptoms are primary causes of long-term functional impairment after acquired brain injury (ABI). Although the occurrence of post-ABI emotional difficulties is well-documented, most investigators have focused on the impact of depression on functioning after ABI, with few examining the role of anxiety. Knowledge of the latter's impact is essential for optimal treatment planning in neurorehabilitation settings. The purpose of the present study is therefore to examine the predictive relationships between cognition, anxiety, and functional impairment in an ABI sample.

Method: Multiple regression analyses were conducted with a sample of 54 outpatients with ABI. Predictors selected from an archival data set included standardized neuropsychological measures and Beck Anxiety Inventory scores. Dependent variables were caregiver ratings of functional impairments in the Affective/Behavioral, Cognitive, and Physical/Dependency domains.

Results: Anxiety predicted a significant proportion of the variance in caregiver-assessed real-life affective/behavioral and cognitive functioning. In contrast, objective neuropsychological test scores did not contribute to the variance in functional impairment. Neither anxiety nor neuropsychological test scores significantly predicted impairment in everyday physical/dependency function.

Conclusion: These findings support the role of anxiety in influencing functional outcome post-ABI and suggest the necessity of addressing symptoms of anxiety as an essential component of treatment in outpatient neurorehabilitation.

Correspondence concerning this article should be addressed to Hilary C. Bertisch, NYU Rusk Institute of Rehabilitation Medicine, 240 East 38th Street, 17th floor, New York, NY 10016. hilary.bertisch@nyumc.org.
Hilary C. Bertisch, Coralynn Long, Donna M. Langenbahn, Joseph F. Rath, Leonard Diller, and Teresa Ashman, Rusk Institute of Rehabilitation Medicine, New York University School of Medicine, New York, New York.
Please note that subsequent to the time of this study, Teresa Ashman is now at the Department of Neurorehabilitation Psychology, Shepherd Center, Atlanta, Georgia.

Keywords

neurorehabilitation; cognitive; emotional; anxiety; function

Introduction

Cognitive and emotional symptoms are primary causes of long-term functional impairments and reduced quality of life after acquired brain injury (ABI; Dawson, Schwartz, Winocur, & Stuss, 2007; Ponsford, Draper, & Schonberger, 2008). According to the World Health Organization, an "impairment" is defined as "an alteration in anatomical, or psychological structures or functions that is the result of some underlying pathology" (Guccione, 1991, p. 500), and "functional impairment" has subsequently been used in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM–IV*) to mean "limitations in the social and occupational spheres of life (Ustün & Kennedy, 2009, p. 83)," which is the operational definition used in the present study. Empirical findings regarding the differential contributions of cognitive and emotional difficulties to functional impairment post-ABI have been inconsistent (Ponsford et al., 2008). Some researchers, particularly in the area of traumatic brain injury (TBI), suggest that functional capacity is affected by both cognitive and emotional factors (Dawson et al., 2007; Ponsford et al., 2008), whereas others conclude that cognitive factors provide the most powerful estimates of functional outcome post-TBI (Sigurdardottir, Andelic, Roe, & Schanke, 2009; Spitz, Ponsford, Rudzki, & Maller, 2012), and still others report that emotional symptoms are more predictive of longer-term functional impairment than are cognitive symptoms (Meares et al., 2006). Similar conflicting findings are observed in the literature on stroke and aneurysm (Al-Khindi, Macdonald, & Schweizer, 2010; Carod-Artal, Trizotto, Coral, & Moreira, 2009; Gangstad, Norman, & Barton, 2009; Hommel, Miguel, Naegele, Gonnet, & Jaillard, 2009). It is plausible that findings differ in part because relationships among emotional, cognitive, and physical factors in individuals with ABI are complex, ill-defined, and difficult to measure (Dawson et al., 2007; Salmond, Menon, Chatfield, Pickard, & Sahakian, 2006).

Most investigations of the impact of emotional factors on post-ABI functioning have emphasized the role of depression (Carod-Artal et al., 2009; Dawson et al., 2007; Hibbard et al., 2004; Schmid et al., 2011). Information about the relationship between anxiety and functional outcome is much more limited (Wood, McCabe, & Dawkins, 2011), despite reported rates of anxiety ranging from 20–70% in the first two years post-injury (Bryant, 2011; Cantor et al., 2005; Draper, Ponsford, & Schonberger, 2007; Moore, Terryberry-Spohr & Hope, 2006; Vaishnavi, Rao, & Fann, 2009). Comparable statistics support the rates of anxiety reported post-stroke (Campbell-Burton et al., 2011, 2012; Vuletić, Sapina, Lozert, Lezaić, & Morović, 2012). Recent evidence suggests that anxiety is a stronger predictor than depression of overall long-term functional impairment in individuals with brain injuries (Draper et al., 2007). According to Hsieh et al. (2012), "anxiety has been identified as the most significant predictor of poor psychosocial outcome, followed by depression and aggression" post-TBI (p. 126).

Remediation of cognitive deficits and alleviation of emotional distress can be considered the short-term goals of neurorehabilitation, with long-term goals including improvements in everyday functional behavior and quality of life (Gleason et al., 2007; Silver, McAllister, & Arciniegas, 2009). Objective neuropsychological data alone are insufficient for informing cognitive rehabilitation efforts (Cicerone, 2012; Rath et al., 2004). Factors influenced by emotional states, such as perception of performance, confidence, and satisfaction with cognitive functioning, are crucial to individuals' appraisals of their own functional competence (Ben–Yishay & Diller, 2011; Cicerone & Azulay, 2007; Rath, Hradil, Litke, & Diller, 2011; Schutz & Trainor, 2007), which in turn contribute to quality of life post-injury (O'Donnell, et al., 2013; Steadman-Pare, Colantonio, Ratcliff, Chase, & Vernich, 2001). A combination of cognitive remediation, pharmacotherapy, and psychotherapy therefore has been identified as gold-standard treatment to address these combined areas of difficulty, with the ultimate goal of improving overall everyday functioning (Silver et al., 2009).

A clearer understanding of the unique contributions of cognitive and emotional factors to everyday functional impairments is essential to effective treatment planning and determining long-term prognosis. The aim of the present study is therefore to investigate the differential contributions of cognitive factors and anxiety to everyday functional impairments.

Method

Participants were selected from an ongoing database of individuals who underwent neuropsychological evaluation at a large, metropolitan outpatient neurorehabilitation program for the past two decades. Therapeutic services provided through this program address both cognitive and emotional difficulties, in individual and group formats. Treatment is aimed at improving real-world functional ability, independence, and subsequent quality of life. Because of the diagnostic heterogeneity found in our program, patients are conceptualized by level of functional impairment, rather than type or severity of injury per se. In this classification system, patients are assigned to treatments based upon a levels-of-residual-competence model, ranging from Level 1 through Level 5, with sets of behaviorally observable criteria delineated for each level (Bertisch, Rath, Langenbahn, Sherr, & Diller, 2011; Langenbahn, Sherr, Simon, & Hanig, 1999; Sherr & Langenbahn, 1992). At intake, each individual undergoes a comprehensive assessment that includes a diagnostic and clinical interview, review of medical records, neuropsychological evaluation, and assessment of mood, personality, and adjustment to injury. Functional data from caregivers are also collected when available. These data are used to determine level of functional impairment and guide individualized treatment recommendations and goals. Because the present study is based on a de-identified archival data set, it received exempt status from the Institutional Review Board at New York University School of Medicine.

Participants

From a larger departmental database, 74 individuals had complete data sets including all relevant Wechsler Adult Intelligence Scale III (WAIS-III; Wechsler, 1997a) and Wechsler Memory Scale III (WMS-III; Wechsler, 1997b) subtests, the BAI, and the Head Injury Family Interview PCL caregiver rating. In an effort to restrict the possible effects of length of time since onset, and still retain an adequately powered sample, individuals selected from this subset were also required to be less than two years post-ABI at the time of assessment. Fifty-four individuals who participated in the program between 2006 and 2008 met all of these requirements. There were no significant differences between the final sample of 54 individuals and the individuals with greater than two years post-ABI in terms of age, $F(1, 73) = .03$, $p = .87$, years of education, $F(1, 73) = .14$, $p = .71$, diagnostic category [$\chi 2 (23, n = 74) = 24.87$, $p = .36$], or gender [$\chi^2(1, n = 74) = .09$, $p = .76$]. Demographic and clinical information on the final sample is provided in Table 1. As patients are required to be medically stable to qualify for treatment in our neurorehabilitation program, all individuals included in the present analyses attained this status before admission.

Predictor Variables

Cognitive functioning.—To minimize the effects of multicollinearity among the cognitive variables, only one subtest representing each essential cognitive domain was selected from the WAIS-III and WMS-III. Standard scores were used for all subtests.

Wechsler Adult Intelligence Scale – Third Edition, Digit Span, Digit Symbol, Similarities, and Block Design subtests.: These subtests (Wechsler, 1997a) represent major cognitive domains (attention/working memory, processing speed, verbal ability, visual-spatial skill, and executive function/abstract reasoning), with an emphasis on tasks sensitive to neurological compromise (Bagiella et al., 2010; Cicerone et al., 2011; Kennedy, Clement, & Curtiss, 2003; van der Heijden & Donders, 2003).

Wechsler Memory Scale – Third Edition, Logical Memory I & II subtests.: These subtests (Wechsler, 1997b) examine the ability to recall contextual information presented in two passages read to the participant. Recall is assessed immediately and at a 20- to 30-minute delay, with a “yes-no” recognition format administered for information not recalled spontaneously.

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988).—The BAI is a 21-item self-report measure that assesses subjective, somatic, or panic-related symptoms associated with anxiety. The BAI requires only a basic reading level, and can be read aloud by an examiner for those with visual/reading difficulties. Total scores are generally reported, as was the case in the present study. Responses range from 0 (*not at all*) to 3 (*severely*). Higher scores represent greater levels of anxiety, ranging from 0 to 9 (*no anxiety*), 10 to 18 (*mild to moderate*), 19 to 29 (*moderate to severe*), and 30 to 63 (*severe anxiety*). The instrument has good internal consistency (.92) and test–retest reliability (.75), as well as acceptable validity. The BAI has been widely used with individuals with ABI (Ashman et al., 2009; Fleming, Strong, & Ashton, 1998; Trahan, Ross, & Trahan, 2001; Wallace & Bogner, 2000; Wood & Doughty, 2013).

Outcome Variable

Functional impairment.—Caregiver ratings are a reliable method for gathering functional status information (Kay, Cavallo, Ezrachi, & Vavagiakis, 1995; Leathem, Murphy, & Flett, 1998; Sneeuw, Sprangers, & Aaronson, 2002; Woolley, Moore, & Katz, 2010;

Zamboni, Grafman, Krueger, Knutson, & Huey, 2010). A caregiver rating was selected as the index of functional ability for the current study as these observational ratings were independent of both patient self-report on the BAI and objective cognitive performance on the WAIS-III and WMS-III. For the purposes of the present study, "functional impairment" was operationalized as "limitations in the social and occupational spheres of life," as used in the *DSM–IV* (Ustün & Kennedy, 2009, p. 83), and quantitatively assessed via the Head Injury Family Interview (HiFi; Kay et al., 1995) PCL, as described below.

The HiFi is a structured interview designed for systematic data collection from patients and/or family members regarding symptomotology post-ABI. Within the HiFi, the Problem Checklist (PCL) is a 43-item observer-rating scale, in which specific symptoms in the emotional, cognitive, and physical domains are rated on a seven-point scale, ranging from 1 to 7, in which "1" indicates that the symptom is "no problem" in terms of impact on daily functioning, "4" represents a "moderate problem," and 7 represents a "severe problem" in terms of daily function. Of the total items, factor analysis of the PCL defined three global scales of everyday functional impairments: 1) Affective/Behavioral [14 items measuring difficulties such as argumentative behaviors, boredom, and tension], 2) Cognitive [9 items measuring problems such as difficulty planning, organizing, and setting realistic goals], and 3) Physical/Dependency [8 items measuring problems such as poor balance, visual difficulties]; Kay et al., 1995. In contrast to other commonly used rating scales that are either intended for use with individuals with extreme impairment (e.g., emergence from coma) or target fewer areas of deficit (e.g., Disability Rating Scale, Hall, Cope, & Rappaport, 1985; Glasgow Coma Scale, Hall et al., 1985; Mayo–Portland Inventory, Malec, 2005; Moss Attention Rating Scale, Hart, Whyte, Ellis, & Chervoneva, 2009; Post-Acute Level of Consciousness Scale, Eilander, et al., 2009), the HiFi PCL has a relatively broad range of functional domains and severity of impairment, considerations that were crucial to its selection as the functional measure for this study. The HiFi PCL has demonstrated good clinical utility, excellent reliability, and the three factor scales demonstrate validity against related measures of functional disability, such as the Patient Competency Rating (Fourtassi et al., 2011; Kashluba, Paniak, & Casey, 2008; Kay et al., 1995; Nabors, Seacat, & Roenthal, 2002; Seel, Kreutzer, & Sanders, 1997). The HiFi PCL has been used in prior ABI research (Paniak, Reynolds, Toller-Lobe, Melnyk, Nagy, & Schmidt, 2002; Rath et al., 2003, 2004; Struchen, Pappadis, Sander, Burrows, & Myszka, 2011).

Data Analyses

Three multiple regression analyses (MRA) were conducted using the Affective/Behavioral, Cognitive, and Physical/Dependency scales on the HiFi as criterion variables, respectively. The cognitive variables (WAIS-III Digit Span, Digit Symbol, Similarities, Block Design, and WMS-III Logical Memory I & II) were entered into one block of the equation, and the BAI was entered into another, as the predictors. Stepwise MRA was selected because, although the predictors were decided a priori, this study is exploratory, and there was no expected effect from the order of entry of the variables into the equation. To determine the effects of anxiety distinct from the cognitive variables, anxiety was entered into a separate block as a predictor within each analysis. Before MRA, histograms for the three HiFi PCL scales (1) Affective/behavioral, (2) Cognitive, and (3) Physical/Dependency were reviewed to assure appropriate variability within each criterion variable. Descriptive data from all inclusive variables is provided in Table 2.

Results

Examination of Multicollinearity and Distributions of HiFi PCL Scores

The Wechsler scales are renowned for their excellent reliability (including internal consistency) and validity (Wechsler, 1997, 1997b), and as such, the individual subtests are not fully independent. Correlations between selected WAIS-III and WMS-III subtests in the current sample ranged from .16 to .90. As indicated above, only one subtest representing each essential cognitive domain was selected for this study in an effort to reduce multicollinearity. There were no cognitive predictor variables that significantly correlated with the BAI.

Descriptive statistics and histograms for each of the HiFi PCL scales evidenced sufficient variability for their inclusion as criterion variables (see Table 2).

Multiple Regression Analyses

As shown in Table 3, results of the regression analyses indicated that only BAI scores significantly predicted impairment on the Affective/Behavioral scale, $F(1, 50) = 5.32$, $p < .05$, Adjusted $R^2 = .079$; and the Cognitive scale, $F(1, 32) = 4.42$, $p < .05$, Adjusted $R^2 = .097$, with the BAI accounting for 9.8% and 12.5% of the variance in caregiver ratings, respectively. No cognitive variables were significant predictors on any scale of the HiFi PCL, and the stepwise entry of all predictor variables rendered the model for the Physical/ Dependency scale nonsignificant.

Discussion

These findings provide preliminary support for the role of anxiety on real-life functional impairment in individuals up to two years post-ABI. This relationship is particularly meaningful in neurorehabilitation settings, as it supports the literature suggesting that anxiety must be addressed not only for reducing distress, but also as a prerequisite for improving everyday functioning and subsequent quality of life in individuals with ABI. The role of anxiety in predicting caregiver-reported disruptions in cognitive function was a novel finding of the present study. Not surprisingly, a relationship between the BAI and the Affect/ Behavioral scale was found, and neither the cognitive predictors nor anxiety significantly predicted physical function.

Strengths of this study include first, that the data were derived from multiple independent sources (objective cognitive tests, self-reports of anxiety, and caregiver ratings), and therefore are robust to systemic factors such as rater bias. Also, as most studies investigating the influence of emotional factors on functional abilities have focused on depression, this study is distinct in its emphasis on the role of anxiety.

Primary limitations of this study include the small, albeit adequately powered, sample size (Cohen, 1992), limitations in the measurement of emotional function, and the multicollinearity across cognitive tests. The latter was addressed within the study design and statistical analyses by the selection of only one subtest representing each essential cognitive domain within the Wechsler scales. Also, the heterogeneity of diagnoses in the present study may limit generalizability across conditions, and it is possible that the relationship between anxiety and outcome may vary by brain injury etiology. Given the small number of individuals in each diagnostic category, however, these differences could not be explored in the current sample.

In addition to these limitations, the BAI, which serves as a program screening tool for general anxiety symptoms, does not capture *all* symptoms of anxiety disorders, and it is possible that patients with other kinds of symptoms (e.g., symptoms specific to Obsessive Compulsive Disorder or Post-Traumatic Stress Disorder) did not endorse clinically significant anxiety on this questionnaire (Moore et al., 2006). The BAI has no symptom-report validity checks or indicators, it is a face-valid measure, and ratings may be influenced by injury-related, non-emotional, or non-anxiety related factors. It is also not beyond the realm of possibility that caregiver ratings of functional impairment may have been inflated in those individuals with anxiety, as their difficulties may have been more easily observable. Anxiety generally manifests with external and observable symptoms, so individuals with higher levels of anxiety may appear more functionally impaired than others (Draper et al., 2007; Hsieh et al., 2012). Likewise, a reverse relationship may be possible, such that individuals with observable functional impairment may be more likely to report anxiety as compared with those more adequately able to complete daily tasks. Another concern is that depression, a primary variable in the ABI functional outcome literature, was not included in this study. Although we acknowledge the important role of depression in the functional status of individuals with ABI, it should be recognized that the goal of this study was to use available data to examine the relative contribution of anxiety and cognitive factors in functional outcome following ABI.

Although interventions for addressing cognitive difficulties and depression have been well-documented (Cicerone et al., 2000, 2005, 2011), methods for the treatment of post-ABI anxiety are not as prominent in the literature. Nonetheless, there is evidence to support the use of interventions such as cognitive–behavioral therapy (CBT) in reducing symptomatology following brain injury (Hsieh et al., 2012; Soo & Tate, 2007; Vaishnavi et al., 2009). For example, Rath et al. (2011) described a cognitive rehabilitation model is which emotional dyscontrol, including significant anxiety, is viewed as a primary contributor to everyday functional impairments, and therefore is addressed in tandem with cognitive dysfunction. Treatment paradigms that address anxiety as a primary contributor to reduced functional status post-ABI should continue to be developed.

Because this is the only known study that has attempted to investigate quantitatively the differential contributions of anxiety and cognition on functional impairments post brain-injury, future studies may aim to replicate this finding with larger samples and more specific measures of anxiety. Because it is possible that the BAI may be an indicator of overall emotional distress, additional measures of mood may also be included to further distinguish the unique role of anxiety in relation to function. Prospective designs with more specific a priori hypotheses regarding the contributing role of anxiety to functional impairment should be implemented. Because anxiety may represent a pervasive factor that influences observer appraisal of both emotional and cognitive function, research should also be conducted to identify more specifically those individual profiles that are most at risk for anxiety, in the service of facilitating appropriate treatment plans. Measures of caregiver burden may also be incorporated as moderator variables.

Acknowledgments

We thank Ora Ezrachi, PhD, author of the HiFi, for her valuable contributions on the use of this measure within the present study. We also thank Jason Krellman, PhD, for his input regarding the role of anxiety in this population.

This research was supported in part by grants from the National Institute of Child Health and Human Development (RO1-HD32943; Leonard Diller, Principal Investigator) and the Anthony M. Solomon Award in Neurorehabilitation.

References

Al-Khindi T, Macdonald RL, & Schewizer TA (2010). Cognitive and functional outcome after aneurysmal subarachnoid hemorrhage. Stroke, 41, e519–e536. doi:10.1161/STROKEAHA.110.581975 [PubMed: 20595669]

Ashman TA, Cantor JB, Gordon WA, Flanagan S, Ginsberg A, Engmann C, & Greenwald B (2009). A randomized controlled trial of sertraline for the treatment of depression in individuals with traumatic brain injury. Archives of Physical Medicine and Rehabilitation, 90, 733–740. doi:10.1016/j.apmr.2008.11.005 [PubMed: 19406291]

Bagiella E, Novack TA, Ansel B, Diaz-Arrastia R, Dikmen S, Hart T, … Temkin N (2010). Measuring outcome in traumatic brain injury treatment trials: Recommendations from the traumatic brain injury clinical trials network. The Journal of Head Trauma Rehabilitation, 25, 375–382. doi:10.1097/HTR.0b013e3181d27fe3 [PubMed: 20216459]

Beck AT, Epstein N, Brown G, & Steer RA (1988). An inventory for measuring clinical anxiety: Psychometric properties. Journal of Consulting and Clinical Psychology, 56, 893–897. doi:10.1037/0022-006X.56.6.893 [PubMed: 3204199]

Ben–Yishay Y, & Diller L (2011). Essentials of holistic neuropsychological rehabilitation. In Handbook of holistic neuropsychological rehabilitation (pp. 7–16). New York, NY: Oxford University Press.

Bertisch H, Rath JF, Langenbahn DM, Sherr RL, & Diller L (2011). Group treatment in acquired brain injury rehabilitation. Journal for Specialists in Group Work, 36, 264–277. doi:10.1080/01933922.2011.613901

Bryant RA (2011). Mental disorders and traumatic injury. Depression and Anxiety, 28, 99–102. doi:10.1002/da.20786 [PubMed: 21284062]

Campbell-Burton CA, Holmes J, Murray J, Gillespie D, Lightbody CE, Watkins CL, & Knapp P (2011). Interventions for treating anxiety after stroke. Cochrane Database of Systemic Reviews, CD008860. doi:10.1002/14651858.CD008860.pub2

Campbell-Burton CA, Murray J, Holmes J, Astin F, Greenwood D, & Knapp P (2012). Frequency of anxiety after stroke: A systematic review and meta-analysis of observational studies. International Journal of Stroke. Advance online publication. doi:10.1111/j.1747-4949.2012.00906.x

Cantor JB, Ashman TA, Schwartz ME, Gordon WA, Hibbard MR, Brown M, & Cheng Z (2005). The role of self-discrepancy theory in understanding post-TBI affective disorders: A pilot study. The Journal of Head Trauma Rehabilitation, 20, 527–543. doi:10.1097/00001199-200511000-00005 [PubMed: 16304489]

Carod-Artal FJ, Trizotto DS, Coral LF, & Moreira CM (2009). Determinants of quality of life in Brazilian stroke survivors. Journal of the Neurological Sciences, 284, 63–68. doi:10.1016/j.jns.2009.04.008 [PubMed: 19411080]

Cicerone KD (2012). Facts, theories, values: Shaping the course of neurorehabilitation. The 60th John Stanley Coulter Memorial Lecture. Archives of Physical Medicine and Rehabilitation, 93, 188–191. doi: 10.1016/j.apmr.2011.12.003 [PubMed: 22289226]

Cicerone KD, & Azulay J (2007). Perceived self-efficacy and life satisfaction after traumatic brain injury. The Journal of Head Trauma Rehabilitation, 22, 257–266. doi:10.1097/01.HTR.0000290970.56130.81 [PubMed: 17878767]

Cicerone KD, Dahlberg C, Kalmar K, Langenbahn DM, Malec JF, Bergquist TF, … Morse PA (2000). Evidence-based cognitive rehabilitation: Recommendations for clinical practice. Archives of Physical Medicine and Rehabilitation, 81, 1596–1615. Review. doi:10.1053/apmr.2000.19240 [PubMed: 11128897]

Cicerone KD, Dahlberg C, Malec JF, Langenbahn DM, Felicetti T, Kneipp S, … Catanese J (2005). Evidence-based cognitive rehabilitation: Updated review of the literature from 1998 through 2002. Archives of Physical Medicine and Rehabilitation, 86, 1681–1692. doi:10.1016/j.apmr.2005.03.024 [PubMed: 16084827]

Cicerone KD, Langenbahn DM, Braden C, Malec JF, Kalmar K, Fraas M, … Ashman T (2011). Evidence-based cognitive rehabilitation: Updated review of the literature from 2003 through 2008. Archives of Physical Medicine and Rehabilitation, 92, 519–530. doi:10.1016/j.apmr.2010.11.015 [PubMed: 21440699]

Cohen J (1992). A power primer. Psychological Bulletin, 112, 155–159. doi:10.1037/0033-2909.112.1.155 [PubMed: 19565683]

Dawson DR, Schwartz ML, Winocur G, & Stuss DT (2007). Return to productivity following traumatic brain injury: Cognitive, psychological, physical, spiritual, and environmental correlates. Disability and Rehabilitation, 29, 301–313. doi:10.1080/09638280600756687 [PubMed: 17364780]

Draper K, Ponsford J, & Schonberger M (2007). Psychosocial and emotional outcomes 10 years following traumatic brain injury. The Journal of Head Trauma Rehabilitation, 22, 278–287. doi:10.1097/01.HTR.0000290972.63753.a7 [PubMed: 17878769]

Eilander HJ, van de Wiel M, Wijers M, van Heugten CM, Buljevac D, Lavrijsen JCM, & Prevo AJH (2009). The reliability and validity of the PALOC-s: A post-acute level of consciousness scale for assessment of young patients with prolonged disturbed consciousness after brain injury. Neuropsychological Rehabilitation, 19, 1–27. doi:10.1080/09602010701694822 [PubMed: 18609020]

Fleming JM, Strong J, & Ashton R (1998). Cluster analysis of self-awareness levels in adults with traumatic brain injury and relationship to outcome. The Journal of Head Trauma Rehabilitation, 13, 39–51. doi:10.1097/00001199-199810000-00006

Fourtassi M, Hajjioui A, Ouahabi AE, Benmassaoud H, Hajjaj-Hassouni N, & Khamlichi AE (2011). Long term outcome following mild traumatic brain injury in Moroccan patients. Clinical Neurology and Neurosurgery, 113, 716–720. doi:10.1016/j.clineuro.2011.07.010 [PubMed: 21840643]

Gangstad B, Norman P, & Barton J (2009). Cognitive processing and posttraumatic growth after stroke. Rehabilitation Psychology, 54, 69–75. doi:10.1037/a0014639 [PubMed: 19618705]

Gleason JF Jr., Case D, Rapp SR, Ip E, Naughton M, Butler JM, … Shaw EG (2007.). Symptom. clusters in patients with newly-diagnosed brain tumors. Journal of Supportive Oncology, 5, 427–433. [PubMed: 18019850]

Guccione AA (1991). Physical therapy diagnosis and the relationship between impairments and function. Physical Therapy, 71, 499–503. [PubMed: 1828899]

Hall K, Cope N, & Rappaport M (1985). Glasgow Outcome Scale and Disability Rating Scale: Comparative usefulness in following recovery in traumatic head injury. Archives of Physical Medicine and Rehabilitation, 66, 35–37. [PubMed: 3966866]

Hart T, Whyte J, Ellis C, & Chervoneva I (2009). Construct validity of an attention rating scale for traumatic brain injury. Neuropsychology, 23, 729–735. doi:10.1037/a0016153 [PubMed: 19899831]

Hibbard MR, Ashman TA, Spielman LA, Chun D, Charatz HJ, & Melvin S (2004). Relationship between depression and psychosocial functioning after traumatic brain injury. Archives of Physical Medicine and Rehabilitation, 4, 43–53. doi:10.1016/j.apmr.2003.08.116

Hommel M, Miguel ST, Naegele B, Gonnet N,& Jaillard A (2009). Cognitive determinants of social functioning after a first ever mild to moderate stroke at vocational age. Journal of Neurology, Neurosurgery & Psychiatry, 80, 876–880. doi:10.1136/jnnp.2008.169672 [PubMed: 19357128]

Hsieh MY, Ponsford J, Wong D, Schonberger M, McKay A, & Haines K (2012). A cognitive behaviour therapy (CBT) programme for anxiety following moderate-severe traumatic brain injury (TBI): Two case studies. Brain Injury, 26, 126–138. doi:10.3109/02699052.2011.635365 [PubMed: 22360519]

Kashluba S, Paniak C, & Casey JE (2008). Persistent symptoms associated with factors identified by the WHO task force on mild traumatic brain injury. The Clinical Neuropsychologist, 22, 195–208. doi:10.1080/13854040701263655 [PubMed: 17853135]

Kay T, Cavallo MM, Ezrachi O, & Vavagiakis P (1995). The Head-Injury Family Interview: A clinical and research tool. The Journal of Head Trauma Rehabilitation, 10, 12–31. doi:10.1097/00001199-199504000-00004

Kennedy JE, Clement PF, & Curtiss G (2003). WAIS-III processing speed index scores after TBI: The influence of working memory, psychomotor speed and perceptual processing. The Clinical Neuropsychologist, 17, 303–307. doi:10.1076/clin.17.3.303.18091 [PubMed: 14704894]

Langenbahn DM, Sherr RL, Simon D, & Hanig B (1999). Group psychotherapy. In Langer KG, Laatsch L, & Lewis L (Eds.), Psychotherapeutic interventions for adults with brain injury or stroke: A clinician's treatment resource. Madison, CT: Psychosocial Press.

Leathem JM, Murphy LJ, & Flett RA (1998). Self- and informant-ratings on the Patient Competency Rating Scale in patients with traumatic brain injury. Journal of Clinical and Experimental Neuropsychology, 20, 694–705, doi:10.1076/jcen.20.5.694.1122 [PubMed: 10079045]

Malec J (2005). The Mayo-Portland Adaptability Inventory. The Center for Outcome Measurement in Brain Injury. http://www.tbims.org/combi/mpai

Meares S, Shores EA, Batchelor J, Baguley IJ, Chapman J, Gurka J, & Marosszeky JE (2006). The relationship of psychological and cognitive factors and opioids in the development of the postconcussion syndrome in general trauma patients with mild traumatic brain injury. Journal of the International Neuropsychological Society, 12, 792–801. doi:10.1017/S1355617706060978 [PubMed: 17064443]

Moore E, Terryberry-Spohr L, & Hope D (2006). Mild traumatic brain injury and anxiety sequelae: A review of the literature. Brain Injury, 20, 117–132. doi:10.1080/02699050500443558 [PubMed: 16421060]

Nabors N, Seacat J, & Rosenthal M (2002). Predictors of caregiver burden following traumatic brain injury. Brain Injury, 16, 1039–1050. doi:10.1080/028990521010155285 [PubMed: 12487718]

O'Donnell ML, Varker T, Holmes AC, Ellen S, Wade D, Creamer M, … Forbes D (2013). Disability after injury: The cumulative burden of physical and mental health. The Journal of Clinical Psychiatry, 74, e137–e143. doi:10.4088/JCP.12m08011 [PubMed: 23473359]

Paniak C, Reynolds S, Toller-Lobe G, Melnyk A, Nagy J, & Schmidt D (2002). A longitudinal study of the relationship between financial compensation and symptoms after treated mild traumatic brain injury. Journal of Clinical and Experimental Neuropsychology, 24, 187–193. doi:10.1076/jcen.24.2.187.999 [PubMed: 11992201]

Ponsford J, Draper K, & Schonberger M (2008). Functional outcome 10 years after traumatic brain injury: Its relationship with demographic, injury severity, and cognitive and emotional status. Journal of the International Neuropsychological Society, 14, 233–242. doi:10.1017/0S1355617708080272 [PubMed: 18282321]

Rath JF, Hradil AL, Litke DR, & Diller L (2011). Clinical applications of problem-solving research in neuropsychological rehabilitation: Addressing the subjective experience of cognitive deficits in outpatients with acquired brain injury. Rehabilitation Psychology, 56, 320–328. doi:10.1037/a0025817 [PubMed: 22121939]

Rath JF, Langenbahn DM, Simon D, Sherr RL, Fletcher J, & Diller L (2004). The construct of problem solving in higher level neuropsychological assessment and rehabilitation. Archives of Clinical Neuropsychology, 19, 613–635, doi: 10.1016/j.acn.2003.08.006 [PubMed: 15271407]

Rath JF, Simon D, Langenbahn DM, Sherr RL, & Diller L (2003). Group treatment of problem-solving deficits in outpatients with traumatic brain injury: A randomized outcome study. Neuropsychological Rehabilitation, 13, 461–488. doi:10.1080/09602010343000039

Salmond CH, Menon DK, Chatfield DA, Pickard JD, & Sahakian BJ (2006). Cognitive reserve as a resilience factor against depression after moderate/severe head injury. Journal of Neurotrauma, 23, 1049–1058. doi:10.1089/neu.2006.23.1049 [PubMed: 16866618]

Schmid AA, Kroenke K, Hendrie HC, Bakas T, Sutherland JM, & Williams LS (2011). Poststroke depression and treatment effects on functional outcomes. Neurology, 76, 1000–1005. doi:10.1212/WNL.0b013e318210435e [PubMed: 21403112]

Schutz LE, & Trainor K (2007). Evaluation of cognitive rehabilitation as a treatment paradigm. Brain Injury, 21, 545–557. doi:10.1080/02699050701426923 [PubMed: 17577705]

Seel RT, Kreutzer JS, & Sanders AM (1997). Concordance of patients' and family members' ratings of neurobehavioral functioning after traumatic brain injury. Archives of Physical Medicine and Rehabilitation, 78, 1254–1257. doi:10.1016/S0003-9993(97)90340-3 [PubMed: 9365357]

Sherr RL, & Langenbahn DM (1992). An approach to large-scale outpatient neuropsychological rehabilitation. Neuropsychology, 6, 417–426. doi:10.1037/0894-4105.6.4.417

Sigurdardottir S, Andelic N, Roe C, & Schanke AK (2009). Cognitive recovery and predictors of functional outcome 1 year after traumatic brain injury. Journal of the International Neuropsychological Society, 15, 740–750. doi:10.1017/S1355617709990452 [PubMed: 19602303]

Silver JM, McAllister TW, & Arciniegas DB (2009). Depression and cognitive complaints following mild traumatic brain injury. The American Journal of Psychiatry, 166, 653–661. doi:10.1176/appi.ajp.2009.08111676 [PubMed: 19487401]

Sneeuw KC, Sprangers MA, & Aaronson NK (2002). The role of health care providers and significant others in evaluating the quality of life of patients with chronic disease. Journal of Clinical Epidemiology, 55, 1130–1143. doi:10.1016/S0895-4356(02)00479-1 [PubMed: 12507678]

Soo C, & Tate R (2007). Psychological treatment for anxiety in people with traumatic brain injury. Cochrane Database System Reviews, 18, CD005239.

Spitz G, Ponsford JL, Rudzki D, & Maller JJ (2012). Association between cognitive performance and functional outcome following traumatic brain injury: A longitudinal multilevel examination. Neuropsychology, 26, 604–612. doi:10.1037/a0029239 [PubMed: 22799747]

Steadman-Pare D, Colantonio A, Ratcliff G, Chase S, & Vernich L (2001). Factors associated with perceived quality of life many years after traumatic brain injury. The Journal of Head Trauma Rehabilitation, 16, 330–342. doi:10.1097/00001199-200108000-00004 [PubMed: 11461656]

Struchen MA, Pappadis MR, Sander AM, Burrows CS, & Myszka KA (2011). Examining the contribution of social communication abilities and affective/behavioral functioning to social integration outcomes for adults with traumatic brain injury. The Journal of Head Trauma Rehabilitation, 26, 30–42. doi:10.1097/HTR.0b013e3182048f7c [PubMed: 21209561]

Trahan DE, Ross CE, & Trahan SL (2001). Relationships among postconcussional-type symptoms, depression, and anxiety in neurologically normal young adults and victims of mild brain injury. Archives of Clinical Neuropsychology, 16, 435–445. doi:10.1016/S0887-6177 [PubMed: 14590158]

Ustun B, & Kennedy C (2009). What is "functional impairment"? Disentangling disability from clinical significance. World Psychiatry, 8, 82–85. [PubMed: 19516924]

Vaishnavi S, Rao V, & Fann JR (2009). Neuropsychiatric problems after traumatic brain injury: Unveiling the silent epidemic. Psychosomatics, 50, 198–205. doi:10.1176/appi.psy.50.3.198 [PubMed: 19567758]

van der Heijden P, & Donders J (2003). WAIS-III factor index score patterns after traumatic brain injury. Assessment, 10, 115–122. doi:10.1177/1073191103010002001 [PubMed: 12801182]

Vuletić V, Sapina L, Lozert M, Lezaić Z, & Morović S (2012). Anxiety and depressive symptoms in acute ischemic stroke. Acta Clinca Croatia, 243–246.

Wallace CA, & Bogner J (2000). Awareness of deficits: Emotional implications for persons with brain injury and their significant others. BrainInjury, 14, 549–562. doi:10.1080/026990500120457

Wechsler D (1997a). Wechsler Adult Intelligence Scale – third edition. San Antonio, TX: The Psychological Corporation.

Wechsler D (1997b). Wechsler Memory Scale – third edition. San Antonio, TX: The Psychological Corporation.

Wood R, & Doughty C (2013). Alexithymia and avoidance coping following traumatic brain injury. Journal of Head Trauma Rehabilitation, *in press*. doi:10.1097/HTR.0b013e3182426029

Wood RL, McCabe M, & Dawkins J (2011). The role of anxiety sensitivity in symptom perception after minor head injury: An exploratory study. Brain Injury, 25, 1296–1299. doi:10.3109/02699052.2011.624569 [PubMed: 22077534]

Woolley SC, Moore DH, & Katz JS (2010). Insight in ALS: Awareness of behavioral change in patients with and without FTD. Amyotropic Lateral Sclerosis, 11, 52–56. doi:10.3109/17482960903171110

Zamboni G, Grafman J, Krueger F, Knutson KM, & Huey ED (2010). Anosognosia for behavioral disturbances in frontotemporal dementia and corticobasal syndrome: A voxel-based morphometry study. Dementia and Geriatric Cognitive Disorders, 29, 88–96. doi:10.1159/000255141 [PubMed: 20150729]

Impact and Implications

- This pilot study extends previous work by exploring the relationship between anxiety and functional impairment after acquired brain injury (ABI). Although the occurrence of post-ABI emotional difficulties is well-documented, most investigators have focused on the impact of depression on functioning after ABI, with few examining the role of anxiety.
- Although preliminary, the results of this study suggest that anxiety influences functional outcome post-ABI, over and above cognitive symptoms.
- Anxiety is a potentially modifiable variable that might be considered in research and clinical settings when working to improve functional outcomes after ABI.

Table 1

Subject Demographics (*n* = *54)*

Characteristic	*n*	%
Gender		
Male	33	61.1
Female	21	38.9
Race		
White	27	50.0
Black	10	18.5
Asian	4	7.4
Hispanic	4	7.4
Missing	9	16.7
Etiology		
TBI	17	31.5
Stroke	19	35.2
Brain/Vascular Disorder	6	11.1
Brain Tumor	2	3.7
Other (includes dementia, MS, Parkinson's Disease, epilepsy, meningitis & electrocution)	10	18.5
Employment Status		
Employed	18	33.3
Unemployed	18	33.3
Retired	5	9.3
SSD/Disability	7	13.0
Other/Missing	6	11.1
	Mean	***SD***
Age at evaluation	54.70	18.21
Months between onset and evaluation	7.35	6.3
Years of education	15.5	2.55

Table 2

Descriptive Statistics for Predictor and Outcome Measures

Measure	***n***	**Mean**	***SD***	**Range**
WAIS Digit Span	54	9.78	3.045	5–17
WAIS Digit Symbol	54	7.28	2.528	3–13
WAIS Similarities	54	10.91	3.728	3–18
WAIS Block Design	54	8.57	3.094	3–17
WMS Logical Memory I	53	8.81	3.669	2–16
WMS Logical Memory II	53	9.38	3.996	1–18
Beck Anxiety Inventory	54	11.33	11.057	0–47
HiFi Affective/Behavioral Scale	52	27.04	21.16	2–84
HiFi Cognitive Scale	34	29.26	17.57	5–58
HiFi Physical Scale	48	15.60	11.73	3–48

Table 3

Summary of Multiple Regression Analyses for Significant HiFi PCL Subscales

	HiFi Affective Scale			HiFi Cognitive Scale			HiFi Physical Scale
Predictor	**β**	***t***	***p***	**β**		***t***	***p***
Beck Anxiety Score	−.313	2.306	.025*	.353	2.10	.044*	< No model >
WAIS Similarities	−.250	−1.89	.065	−.137	−.811	.424	
WAIS Digit Span	.032	.233	.817	.103	.601	.552	
WAIS Digit Symbol	−.061	−.438	.663	.128	.747	.461	
WAIS Block Design	−.137	−1.01	.322	.054	.304	.763	
Logical Memory I	−.194	−1.45	.154	−.229	−1.38	.178	
Logical Memory II	−.171	−1.278	.211	−.241	−1.44	.424	

* $p < .05$.