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Dispositional optimism and outcome following traumatic brain injury

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Abstract

Objective: Despite vast literature examining the predictors of patient outcome following traumatic brain injury (TBI), the complicated relationship between personality and psychological, cognitive and functional outcomes remains poorly understood. The present study examined the relationship between the personality trait of dispositional optimism (DO) and outcome after moderate and severe TBI in the context of a proposed theoretical model.

Methods: Forty-five individuals who had sustained moderate-to-severe TBI were recruited through mailings and completed the Symptom Checklist Questionnaire-90 Revised (SCL-90-R), the Telephone Interview for Cognitive Status (TICS), the Craig Handicap Assessment Reporting Technique (CHART) and the Life Orientation Test-Revised (LOT-R). Analyses were conducted to test a model predicting the relationship between personality and patient outcome after TBI.

Results: DO was significantly correlated with psychological distress, but did not predict functional outcome. In addition, two significant mediating relationships were demonstrated: (1) psychological distress was shown to mediate the relationship between dispositional optimism and cognitive ability and (2) cognitive ability mediated the relationship between psychological distress and functional outcome.

Conclusion: These findings illustrate that higher levels of DO in individuals sustaining moderate-to-severe TBI are related to better psychological functioning which in turn predicts improved cognitive and functional outcomes.

Keywords: *Traumatic brain injury, dispositional optimism, psychological distress, cognitive ability, functional outcome*

Introduction

In the US, the approximate incidence of TBI is 2 million per year and 80,000 of these individuals will live with chronic disability as a result of their injury [1, 2]. The consequences of TBI involve physical disability, emotional disturbances, cognitive impairments and behavioural problems [3–7]. In addition, many individuals also experience difficulties with psychosocial and occupational adjustment after their injury [8–10]. The varied consequences of TBI maintain high comorbidity; thus individuals often cope with a combination of psychiatric, cognitive and functional problems following the injury. Within the literature documenting outcomes following TBI, few studies have examined the relationships between psychiatric and cognitive factors on functional outcome [11]. Thus, one goal of this study is to examine how the common psychiatric and cognitive sequelae of TBI influence functional outcome.

One of the largest literatures in the study of TBI has to do with the prediction of patient outcome (broadly defined). Predictor variables that have been linked to psychological, cognitive or functional outcomes following TBI include: Glasgow Coma Scale [10, 12–21], duration of post-traumatic amnesia and coma [22–25], socioeconomic status and

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ethnic minority status [3, 15, 26–28], lesion location and mechanism of injury [29, 30] and pre-morbid intelligence and cognitive ability [31, 32]. One area of outcome prediction, however, that has not been well researched within the TBI literature is the influence of personality traits on outcomes following injury. The personality trait of dispositional optimism (DO) is a primary focus of the current study and refers to an individual's expectation of a positive outcome in most situations [33].

Research in the area of positive psychology has found associations between DO and better health and coping strategies, while despair, depression and hopelessness show a greater relationship to illness and death in the general population [34–36]. Individuals scoring higher on scales of DO have been shown to confront medical, psychological and physical adversity with greater success than those with lower scores and this effect has been demonstrated in patients diagnosed with epilepsy [37], breast cancer [38], post-partum depression [39] and spinal cord injury [40]. In addition, a review by Affleck et al. [41] found that higher levels of DO predicted better coping with medical ailments, such as coronary artery bypass surgery [42], bone marrow transplantation [43], arthritis [44], HIV-positive status and cancer [45]. Various researchers have corroborated the aforementioned findings that DO may play a vital role in behavioural, psychological and physical outcomes after adverse events [46–49]. Personality traits, such as DO, might buffer detrimental consequences and prove to be a useful predictor of psychiatric, cognitive and functional outcomes after TBI. Little work in this area has been extended to individuals with neurological disorders, where cognitive, emotional and perceptual processes may have been altered due to injury or disease. The only work to date examining DO following TBI documented relationships between DO and health outcomes, quality-of-life [50, 51] and depression [52]. DO has been shown to be predictive of improved outcome in a number of medical disorders, but the influence of this personality trait on psychiatric, cognitive and functional outcomes in a group of patients with TBI remains under-studied. This study examines the associations between DO and long-term outcomes following TBI in order to extend our understanding of the inter-relationships between personality, clinical symptoms and patient outcome following TBI.

In the current study, we anticipate that DO will influence the psychiatric sequelae, cognitive difficulties and, ultimately, functional limitations associated with TBI. Thus, the goal of this study is to examine how a personality factor, such as DO, might interact with and influence psychological, cognitive and, ultimately, functional outcome after moderate and severe TBI. To examine these relationships a theoretical model is proposed and tested, describing the possible associations between DO and the consequences of TBI (see Figure 1).

The model proposed here is based upon several relationships previously demonstrated between these predictor and outcome variables. For example, work by Ponsford et al. [11] demonstrated that cognitive deficits and higher levels of anxiety are associated with poorer functional outcome. Prior work by Fann et al. [53] also demonstrates that individuals with TBI with symptoms of depression and/or anxiety show greater functional disability compared to individuals with TBI without similar psychiatric symptoms and that increased psychological distress is

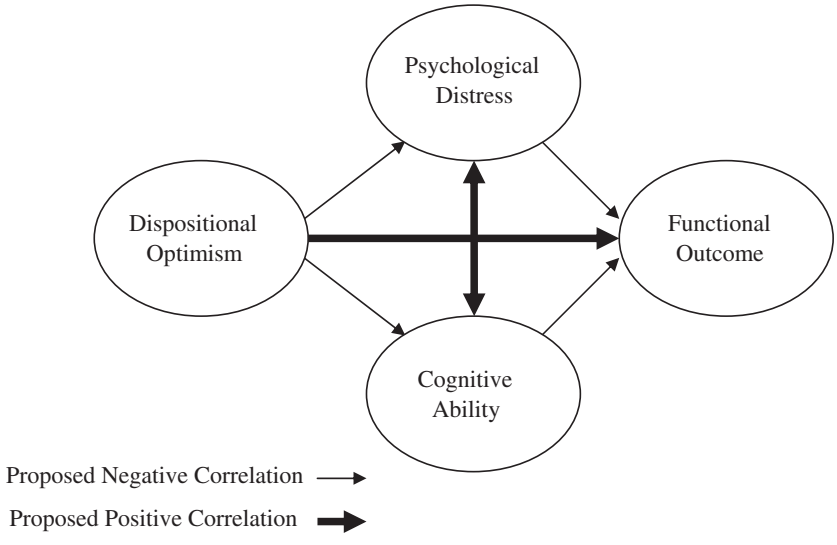

Figure 1. Proposed model.

associated with more self-reported cognitive deficits. With regard to the influence of psychological distress on TBI outcome, much of the prior work focuses on depression and anxiety and it was a goal of this study to measure psychological distress across a number of dimensions in addition to depression and anxiety.

Study goals

The consequences of TBI have a profound influence on everyday functioning and independent living. One important goal of this study is to recruit individuals with severe TBI and limitations to community access. The current study utilized mailings and telephone interviews with the goal of enrolling individuals who might not typically participate in research. In doing so, the aim was to recruit individuals with significant deficits in order to understand the psychiatric, cognitive and functional outcomes following TBI. Moreover, the aim was to determine how DO relates to outcomes following TBI by testing the theoretical model proposed here. DO has been shown to relate to better physical well-being and social functioning in other patient populations and it was hypothesized that a direct relationship would exist between DO and psychiatric, cognitive and functional outcomes in a group of individuals with moderate and severe TBI.

Methods

Participants and procedure

Forty-five individuals sustaining moderate and severe TBI were involved in this study, including 25 males and 20 females, four of whom identified their ethnicity as African-American and one as Asian (see Table I). Subjects were recruited through the Hershey Medical Center Trauma Database and from prior research studies. With permission from the Hershey Medical Center Institutional Review Board, thorough medical chart reviews were conducted to indentify subjects meeting inclusionary criteria for the study. Recruitment letters and flyers for the current study were only mailed to individuals who had sustained a verifiable brain injury documented by a 24-hour GCS of 12 or lower and/or positive CT/MRI findings at the time of injury, had mailing addresses listed in their medical charts and were over 18 years of age at the time of the mailing. Medical chart review was also used to rule out individuals with significant psychiatric history such as schizophrenia or bipolar disorder and neurological disorders such as epilepsy or cerebrovascular accident. The subjects involved in this research were between the ages of 18–68 years.

Prospective participants were mailed recruitment materials regarding the study. Respondents were then sent a 'Study Package' which included the information about the study, several self-report measures and a pre-addressed and pre-stamped envelope for return of self-report questionnaires. During the phone interview, the interviewer first reviewed the goals of the study and obtained verbal consent to participate before beginning the study. Following consent, the interviewer followed a phone script and facilitated the completion of the self-report measures. All study participants completed two self-report measures independently without input from the phone interviewer (SCL-90 and LOT-R) and the remaining two questionnaires were administered by the phone interviewer (TICS and CHART) (described in greater detail below). When the completed questionnaires were received in the mail, subjects were paid $30 for their participation.

Measures

The Symptom Checklist Questionnaire-90-Revised. The SCL-90-R provides an overview of a patient's symptoms and their intensity at a specific point in time. The self-report questionnaire includes 90 items that are scored on a five-point Likert scale. The scales included in the questionnaire are

Table I. Participant characteristics.

Variable	*M* (*z*-score)	SD	Min	Max	Normative data
Age	34.1	12.5	20.0	68.0	
Education (years)	13.0	2.1	9.0	20.0	
GCS	5.6	3.0	3.0	12.0	
Time since injury (years)	7.0	6.7	1.0	22.2	
SCL-90-R	1.8 (1.14)	0.6	1.0	3.1	1.32 (SD = 0.42)
LOT-R			2.0	24.0	
Males	12.9 (−0.32)	5.75			14.28 (SD = 4.33)
Females	14.4 (0.002)	5.22			14.42 (SD = 4.28)
TICS	31.1 (−2.68)	4.6	19.5	39.0	35.79 (SD = 1.75)
CHART	89.9	16.0	39.5	100.0	Max score = 100

SCL-90-R = Symptom Checklist Questionnaire-90-Revised, Positive Symptom Distress Total; TICS = Telephone Interview for Cognitive Status; LOT-R = Life Orientation Test-Revised; CHART = Craig Handicap Assessment Reporting Technique.

somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. For the current study, the positive symptom distress total on the SCL-90-R was used to measure psychological distress [54].

Life Orientation Test-Revised (LOT-R). The LOT is a brief self-report measure of dispositional optimism created by Scheier and Carver [33]. The LOT-Revised [47] was used for the current study and provides a continuous distribution of scores, therefore people range from very optimistic to very pessimistic. It contains three positive expectancy items (e.g. In uncertain times, I usually expect the best), three negative expectancy items (e.g. I rarely count on good things happening to me) and also four filler items. Respondents indicate level of agreement with each item on a 5-point scale with a range from *strongly agree* (4) to *strongly disagree* (0). When scoring the LOT-R, a high score is interpreted as optimistic (highest possible score is 24) and a low score as pessimistic (lowest possible score is 0). The test has acceptable psychometric and discriminate validity properties in relation to related concepts of locus of control, hope, extraversion and self-efficacy.

The Telephone Interview for Cognitive Status (TICS). The TICS [55] is a screening measure for individuals at risk for cognitive deficits and permits screening for cognitive impairment without requiring in-person contact. The TICS correlates very highly with the Mini Mental Status Examination (a similar measure of cognitive ability, though administered through an in-person interview) and it is also able to discriminate individuals experiencing mild symptoms of Alzheimer's disease from healthy controls. In addition, it has previously been utilized in research on individuals with TBI to identify cognitive deficits [56, 57]. The TICS consists of 12 items, with a total possible score of 51.

The Craig Handicap Assessment Reporting Technique (CHART). The CHART is a multidimensional outcome instrument that measures the degree to which impairments and disabilities result in handicaps in six domains: (1) Physical Independence: ability to sustain a customarily effective independent existence; (2) Mobility: ability to move about effectively in one's surroundings; (3) Occupation: ability to occupy time in the manner customary to that person's sex, age, and culture; (4) Social Integration: ability to participate in and maintain customary social relationships; (5) Economic Self-Sufficiency: ability to sustain customary socio-economic activity and independence; and (6) Cognitive Independence. The highest score for each of the six domains measured is 100 and total functional independence is calculated by averaging all the domains. In the current study, scale 5 was not utilized in determining the total functional independence level because several subjects did not provide enough information about income to have an Economic Self-Sufficiency scale score (i.e. subjects did not want to disclose annual household income during the telephone interview). The instrument was designed to be administered by interview, either in person or by telephone and the short-form, used in the current study, takes ~15 minutes to administer [58].

Results

Descriptive statistics were calculated and, where relevant, these data were compared with normative test data, see Table I. In addition, the correlations between the clinical and demographic variables were computed, see Table II.

Testing the proposed model

The proposed model was tested in three separate parts using partial correlations and regression analyses, see Figures 2a–c.

Testing part 1 of the proposed model

As indicated in Table II, DO is significantly correlated with psychological distress, ($r(44) = -0.55$, $p < 0.001$) but did not significantly correlate with cognitive ability after statistical correction. Partial correlations were utilized to examine if DO had unique relationships with psychological distress and cognitive ability. The first partial correlation controlled for cognitive ability and tested the relationship with DO and psychological distress. Results indicate a significant relationship between DO and psychological distress, when controlling for cognitive ability ($r(44) = -0.47$, $p < 0.05$). The partial correlation between DO and cognitive ability, controlling for psychological distress, was not significant ($r(44) = 0.06$, $p < 0.694$). Due to the latter finding, a mediation model was tested to determine if psychological distress mediates the relationship between DO and cognitive ability. Regression analysis was used to test this mediating relationship and results are shown in Table III. In the first regression analysis, DO was entered first and psychological distress was entered second and both steps were significant. The second analysis, with psychological distress entered first and DO entered second, indicates that only the first step is significant and that

Table II. Pearson correlations between variables.

	SCL-90-R	TICS	CHART	LOT-R	GCS	Age	Years post-TBI	Education
SCL-90-R	1.00							
TICS	−0.54**	1.00						
CHART	−0.46*	0.47**	1.00					
LOT-R	−0.55**	0.34	0.08	1.00				
GCS	−0.12	0.17	0.11	0.34	1.00			
Age	0.02	0.20	−0.12	0.09	0.26	1.00		
Years post-TBI	0.06	0.09	−0.11	0.05	−0.01	−0.31	1.00	
Education	−0.42*	0.45*	0.33	0.21	0.21	−0.02	0.04	1.00

Significance was adjusted using Bonferroni's correction. *$p < 0.05$ after Bonferroni correction; **$p < 0.01$ after Bonferroni correction.

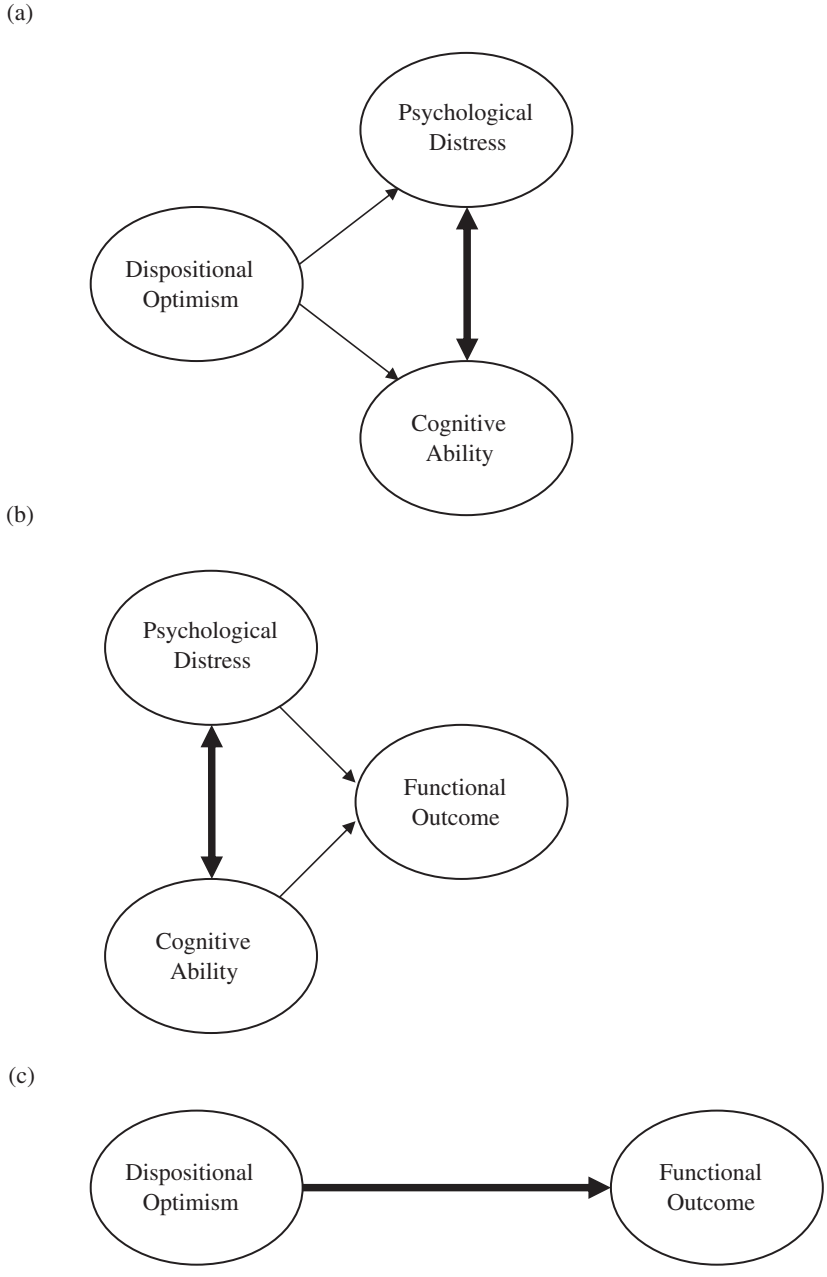

Figure 2. Parts of the proposed model to be tested.

Table III. Regression analyses of the effects of psychological distress and dispositional optimism on cognitive ability.

Predictor of cognitive ability	Change in R^2	β
Dispositional optimism	0.118*	0.343
Psychological distress	0.178**	−0.507
Total R^2	0.296	
Psychological distress	0.293**	−0.541
Dispositional optimism	0.003	0.062
Total R^2	0.296	

*$p < 0.05$; **$p < 0.01$.

Table IV. Regression analyses of the effects of cognitive ability and psychological distress on functional outcome.

Predictor of functional outcome	Change in R^2	β
Cognitive ability	0.219**	0.476
Psychological distress	0.060	−0.290
Total R^2	0.279	
Psychological distress	0.210**	−0.459
Cognitive ability	0.069*	0.310
Total R^2	0.279	

*$p < 0.05$; **$p < 0.01$.

DO does not account for new variance in functional outcome when psychological distress is entered first. Therefore, psychological distress mediates the relationship between DO and cognitive ability.

Testing part 2 of the proposed model

Correlations in Table II show that functional outcome is correlated with psychological distress and cognitive ability ($r(44) = -0.46$, $p < 0.05$) and ($r(44) = 0.47$, $p < 0.001$), respectively.

To further examine part 2 of the model, partial correlations were used. The first partial correlation controlled for cognitive ability and tested the relationship with functional outcome and psychological distress. Results indicate a non-significant relationship between functional outcome and psychological distress, when controlling for cognitive ability ($r(44) = -0.27$, $p < 0.073$). The partial correlation between functional outcome and cognitive ability, controlling for psychological distress, was significant ($r(44) = 0.29$, $p < 0.05$). Due to the findings indicating that controlling for cognitive ability results in a non-significant relationship between functional outcome and psychological distress, another mediation model was tested to determine if cognitive ability mediates the relationship between functional outcome and psychological distress. Regression analysis was used to test this mediating relationship and results are shown in Table IV. In the first analysis, cognitive ability was entered first and psychological distress was entered second and demonstrates that psychological distress does not account for a significant amount of new variance in functional outcome. The second analysis, with psychological distress entered first and cognitive ability entered second, indicates that both steps are significant and that cognitive ability accounts for new variance in functional outcome when psychological distress is accounted for and is a mediator in this relationship.

Testing part 3 of the proposed model

Table II indicates that there is a non-significant correlation between DO and functional outcome, therefore this direct relationship was not further tested and was eliminated from the proposed model. The resultant model, after testing the inter-relationships between factors, is shown in Figure 3. (Note: directionality is assumed in the depiction of the model for clarity, however, additional work, likely including time series data are needed to confirm the causal directions proposed here.)

Post-hoc analyses

In addition to analyses to directly examine the hypothesized model, post-hoc analyses were conducted to determine what factors influence levels of DO in order to better understand this personality trait in the current sample. As shown in Table II, DO did not significantly correlate with injury severity (GCS) after statistical correction. Because there may be limited variance in GCS scores for correlational analysis, to further examine this relationship, a median split was used to create two separate injury severity groups. Group 1 contained 23 individuals with GCS scores of 3–5 ($M = 3.22$, SD = 0.52) and Group 2 contained 22 individuals with GCS scores of 6–12 ($M = 8.19$, SD = 2.20). These sub-groups differed in their mean DO levels, 11.78 (SD = 4.90) for lower GCS scores and 15.48 (SD = 5.37) for individuals with higher GCS. A one-way ANOVA showed that these differences were statistically significant, $F(1) = 5.691$, $p < 0.022$; individuals sustaining more severe injuries demonstrated lower levels of DO. No other demographic or clinical factor was related to DO in the current sample.

DO was further examined in these two groups by comparing whether the lower GCS group differed in levels of DO from the normative sample. As a group, the TBI sample did not differ significantly from the normative data on levels of DO. However, a *t*-test showed that the lower GCS group did significantly differ in scores for DO compared to the normative

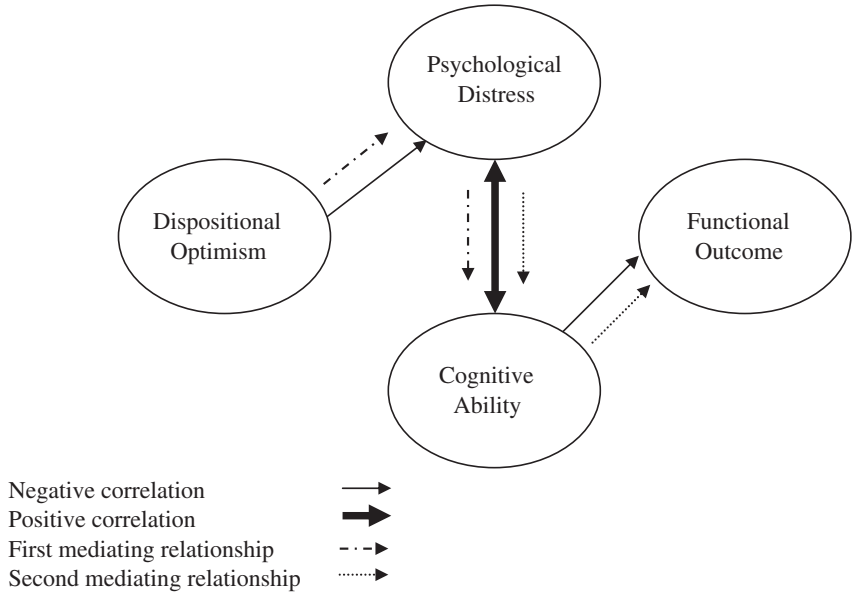

Figure 3. Model of dispositional optimism and outcome following TBI. Solid lines indicate correlations between variables. Dotted lines represent mediating relationships.

sample, $t(22) = -2.51$, $p = 0.020$, where individuals with more severe injuries had lower mean DO scores.

It was also of interest to further elucidate the relationship between DO and psychological distress by examining the sub-scales of the SCL-90. DO was highly correlated with all symptom scales of the SCL-90 (e.g. Depression: $r(44) = -0.58$, $p < 0.001$, Paranoid Ideation: $r(44) = -0.59$, $p < 0.001$, Obsessive Compulsive: $r(44) = -0.59$, $p < 0.001$). Due to the fact that these scales are correlated with each other, covarying out any one of the symptom scales eliminated the relationship between DO and the symptom scales. Therefore, in the current data, the scales of the SCL-90 were highly correlated and lower levels of DO predicted increase in overall psychological distress, regardless of the symptom area.

Discussion

The current study is, to the authors' knowledge, the first to examine the relationship between DO with psychiatric, cognitive and functional patient outcomes following moderate and severe TBI. The model examined here focused on the relationship of DO with psychiatric and cognitive outcomes and the ultimate goal was to examine how these factors relate to functional outcome following TBI.

The results here indicate that DO is an important predictor of psychological distress even when eliminating variance accounted for by cognitive ability, but that DO is not uniquely correlated with cognitive ability. This was a surprising finding; in the current data, DO is related to cognitive ability through psychological distress, which was shown to be a mediator in this relationship. Testing the second part of the model demonstrated that psychological distress and functional ability are correlated, but that this relationship is not significant when cognitive ability is controlled for, leaving cognitive ability as a mediator between psychological distress and functional outcome. Based upon the findings, the hypothesized link between DO and functional outcome was not supported; however, the results did reveal that DO is an important predictor variable of psychological distress and that psychological distress predicts cognitive ability.

The primary finding that DO predicts psychological distress is consistent with prior work demonstrating that DO may act as a buffer against the detrimental psychological consequences of disease and injury. As demonstrated in the post-hoc analyses, all scales of the SCL-90 are highly intercorrelated and DO was related to psychiatric symptoms more generally and was not simply a surrogate for any specific symptom or response style (e.g. depression). Therefore, individuals sustaining TBI who are low in DO (e.g. maladaptive coping strategies, pessimism) may be at a greater risk for

psychological distress, which may contribute to cognitive and functional impairment. Thus, DO might be a specific target variable during TBI intervention; individuals sustaining TBI could benefit from psychoeducation about injury, recovery and rehabilitation employing similar interventions used in medical disorders to target specific maladaptive schemas and enhance coping strategies [59, 60].

It should be emphasized that it was a goal in this study to examine more severe forms of TBI and include individuals who often do not participate in TBI studies and are therefore under-represented in the TBI literature. The recruitment methods used in this study resulted in a sample with severe injuries. The mean GCS in the current sample was 5.6 (SD = 3.0), which is lower than important prior work examining patient outcome following moderate and/or severe TBI [61–66]. Therefore, the recruitment methods used in this study were successful in accessing a group that may be difficult to study, potentially due to functional limitations and/or limited community access and transportation.

One interesting finding, given the nature of this sample, is that the mean DO values in this TBI sample were not significantly different compared to the LOT-R normative sample when initially compared. When further examined in post-hoc analyses, individuals in a low GCS group had significantly lower levels of DO compared to the normative data. That is, the TBI group as a whole did not differ from the normative sample, but when individuals with the most severe injuries in the sample were further examined, unlike those less severely injured, they demonstrated lower levels of DO compared to a normative healthy sample. There are some possible explanations for this. It could be that individuals with lower levels of DO tend to sustain more severe injuries or it is possible that sustaining severe injuries may lower one's level of DO. It could also be the case that the recovery for individuals following more severe TBI is longer, more difficult and with poorer outcomes, resulting in less optimism and positive coping. DO may also change over the course of recovery, but could increase more for individuals with less severe injuries. Work by Tomberg et al. [50] examined longitudinal changes in optimism following TBI (first follow-up was ~2.3 years post injury and second follow-up was ~5.7 years later). Results showed that TBI patients were more optimistic at the second follow-up, though this was not correlated to quality-of-life and social outcomes. In the current study, the number of years post-injury was not significantly correlated with levels of DO. Continued work using longitudinal approach (with or without directed DO intervention) is required to determine to what extent optimism is useful as a buffer to the consequences of TBI and how DO might be altered during, the recovery process. In addition, examining pre-morbid levels of DO (through significant other report) and measuring DO following TBI will be important to better understand how brain injury effects DO.

The current study provided novel findings regarding the relationship between psychiatric, cognitive and functional outcomes following TBI and further provides evidence about how personality may interact with outcome following moderate and severe TBI. This study extends important work by Tomberg et al. [50, 51] by examining the psychiatric, cognitive and functional consequences of TBI together in a working model, providing a framework in which DO and outcomes can be further explored. Despite this, a number of limitations are noteworthy. Although directionality is implied in the model and interpretation of the results for ease of discussion, the approach taken here does not allow for causal relationships to be determined between variables. Therefore, although the analyses reveal several important relationships between cognitive, psychiatric and functional outcomes following TBI, the cause and direction of these relationships require verification via additional methods. Furthermore, only cross-sectional measurements of DO, psychological distress, cognitive ability and functional status were conducted and therefore recovery, factors influencing change over time and pre-morbid personality can not be sufficiently determined from the current results. In addition, self-report was used to measure all of these outcomes, rather than caregiver report for corroboration or a structured clinical assessment.

In conclusion, the findings presented here provide support for the relationship between DO and distinct outcomes after TBI and the result is a working model to guide thinking about the relationships between these outcome variables. Specifically, DO may serve as an important predictor of psychological distress following injury. Future studies should aim to identify other personality factors that contribute to the understanding of functional outcomes in order to continue to understand how personality and coping strategies add to resiliency during the recovery process following TBI. Incorporation of longitudinal research designs and treatment outcome studies continue to be vital. In sum, multiple and often overlapping factors exist that contribute to patient outcome after TBI and both pre-morbid and post-injury personality factors (e.g. DO) may be critical determinants of outcome. Because of this, factors such as DO require continued consideration in TBI research, not only in statistical modelling of patient outcome, but also in the development of future clinical interventions.

Declaration of Interest: The authors report no conflicts of interest and do not have a financial investment in this study or the outcome of the data.

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