The effect of injury diagnosis on illness perceptions and expected Postconcussion Syndrome (PCS) and Posttraumatic Stress Disorder (PTSD) symptoms.

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Acknowledgements

The Human Research Ethics Committee of Queensland University of Technology (QUT-HREC #1000000311) approved this research. This project was granted an occupational workplace health and safety clearance. Funding for this project was provided by the School of Psychology and Counselling, Queensland University of Technology. Parts of this project were presented at the Australian Psychological Society, College of Clinical Neuropsychology Conference, Launceston Tasmania, 22-25 November, 2012. The authors declare no conflict of interest.

Manuscript word count (4500 max): approx 4330 Abstract word count (200 max): 200

Abstract

Objective: To determine if systematic variation of diagnostic terminology (i.e. concussion, minor head injury [MHI], mild traumatic brain injury [mTBI]) following a standardized injury description produced different expected symptoms and illness perceptions. We hypothesized that worse outcomes would be expected of mTBI, compared to other diagnoses, and that MHI would be perceived as worse than concussion. Method:108 volunteers were randomly allocated to conditions in which they read a vignette describing a motor vehicle accident-related mTBI followed by: a diagnosis of mTBI (*n*=27), MHI (*n*=24), concussion (*n*=31); or, no diagnosis (*n*=26). All groups rated: a) event 'undesirability'; b) illness perception, and; c) expected Postconcussion Syndrome (PCS) and Posttraumatic Stress Disorder (PTSD) symptoms six months post injury. Results: On average, more PCS symptomatology was expected following mTBI compared to other diagnoses, but this difference was not statistically significant. There was a statistically significant group effect on undesirability (mTBI>concussion & MHI), PTSD symptomatology (mTBI & no diagnosis>concussion), and negative illness perception (mTBI & no diagnosis>concussion). Conclusion: In general, diagnostic terminology did not affect anticipated PCS symptoms six months post injury, but other outcomes were affected. Given that these diagnostic terms are used interchangeably, this study suggests that changing terminology can influence known contributors to poor mTBI outcome.

Keywords: neuropsychology, head injury, acquired brain injury, neurocognitive disorder, posttraumatic stress disorder, postconcussion syndrome, mild traumatic brain injury.

The effect of injury diagnosis on illness perceptions and expected Postconcussion Syndrome (PCS) and Posttraumatic Stress Disorder (PTSD) symptoms.

Several factors have been identified as contributing to the different injury outcomes experienced by individuals after a mild traumatic brain injury (mTBI). Early models posited a role for two, albeit relatively poorly defined factors that were thought to contribute to poor outcome. These early models, which identified a role for psychological (or psychogenic) or biological (organic) processes, have since been critiqued.[1] Current models implicate a range of biopsychosocial factors as contributors to injury outcome, most of which have a substantial evidence base,[2] and the possibility that these factors differentially contribute to recovery over time has been raised.[3,4]

Patient expectation is one of the factors that is implicated in current models of negative outcome post mTBI.[2] The importance of this variable as a potential contributor to poor mTBI recovery was highlighted over 20 years ago with the articulation of the expectation-as-etiology hypothesis.[5] Expectation is thought to play a role in injury outcome via cognitive processes. That is, if an injury occurs in a person who has negative preexisting ideas about mTBI, these ideas may lead an individual to misattribute benign or every day symptoms as pathological, and due to the injury. [5] This problem is compounded by the nature of the symptoms that may persist following mTBI. Such symptoms are common and non-specific[6-8] providing ample opportunity for misattribution.

Indirect support for the idea that expectation could have such a role in poor mTBI recovery comes from studies that show that negative associations with mTBI are present in naïve[9,10] and mTBI patient populations one to three months post injury.[11] For example, Whittaker and colleagues showed that, compared to other psychological variables, the *perceived* long term consequences of mTBI assessed early post injury, were the best predictors of *actual* symptoms and functional outcome three months post injury. [11] In a comment on Whittaker and colleagues' work, Ferrari[12] suggested that investigation of patient-held beliefs about their illness, which include recovery expectation, is one of the most relevant areas of mTBI research because of the potential for preventative interventions. As such, it is of interest whether illness perception can be manipulated. One possible avenue for manipulating injury perception may be by varying the terminology initially used to describe or diagnose the injury.

The possibility that injury expectation and even behavior may be influenced by mTBI diagnostic terminology is suggested by several studies. Using a community sample of 103 adults McLellan and colleagues showed that the term *brain* injury was associated with more negative attributions than the same injury, labeled *head* injury.[9] In the same population, the term brain injury was more likely to be associated with the word 'negative' than the term, head injury.[10] In a study of 224 university athletes, Weber and Edwards[13] found that worse outcomes were expected of an injury described as a mTBI, as opposed to a concussion or minor head injury. Furthermore, the report by DeMatteo and colleagues[14] suggests an attempt to manipulate expectation in clinical contexts, where pediatricians prefer the term concussion to mTBI because it is "less alarming" (p. 327). The effect of varying terminology on behavior *per se* is demonstrated by the so-called 'diagnosis threat' studies. These studies show that, compared to neutral test instructions, instructions that draw attention to a head injury result in worse performance on selected neuropsychological[15,16*] or cognitive complaint measures.[17] Further, at the other extreme, the term concussion is regarded as one that may promote expectations of a more positive prognosis.[18].

[*] For an exception see Ozen and Fernandes.[17]

The aim of this study was to extend this past research by determining if an effect of diagnostic terminology was present on several key outcomes, including expected PCS symptoms six months post injury. Given that the International Classification of Diseases (ICD-10) research criteria for a PCS diagnosis relies heavily on the presence of such symptoms[19] an effect of such terms on expected symptoms is important. To the best of our knowledge, only one other study has examined the impact of diagnostic terms on PCS symptomatology.[13] This study by Weber and Edwards showed that actual symptom reporting using the Rivermead Postconcussion Questionnaire was *not* impacted by terminology.[13] However, this study used university athletes to examine sports-related mTBI and it has been suggested that athletes have different injury expectations than other people.[20] To improve on the methodology of the Weber and Edward study,[13] we: a) used a vignette to standardize the injury context; b) changed the injury details to test the effect of terminology following a motor vehicle accident (MVA)-related mTBI; c) employed a measure of symptoms recommended by the TBI common outcomes workgroup;[21] d) included a no diagnosis control group; and, d) used a general university sample rather than a sample of university athletes. We included a no diagnosis condition as a control, but also because many people who sustain a mTBI do not seek treatment and may never be formally diagnosed. We also sought to determine the effect of varied terminology on other outcomes (expected PTSD symptoms and illness perception) using a broader range of terms than has been attempted previously. The decision to include expected PTSD symptoms as an outcome was partly based on the fact that trauma is referenced in one diagnostic term (mTBI) but not others, and this could skew perceptions of this injury.

The hypotheses for this study were that, compared to concussion or MHI, the term mTBI would lead to: a) greater expected PCS and PTSD symptomatology, and; b) worse injury outcome, defined in terms of higher expectation of serious consequences, longer recovery, and greater undesirability. These directional hypotheses were proposed because the previous literature has shown that: a) in community samples, the term brain injury leads to worse attributions than head injury[9,10] b) that PTSD symptoms can be elicited by mTBI vignettes[22] and; c) in athletes, the term mTBI is more likely to lead to worse item-level outcome expectation than minor head injury or concussion.[13†] Different outcomes for MHI and concussion (MHI worse than concussion) were also expected, although the basis for this prediction was weaker as fewer studies have directly compared these terms. Weber and Edwards found only one such difference which indicated that more university athletes agreed with the statement that a sports person with MHI would be less likely to withstand the effects of subsequent injury than a concussed individual.[13] The no diagnosis condition was expected to produce fewer negative outcomes than experimental conditions, because this condition was not expected to activate the stereotypes that have been implicated in the diagnosis-threat literature. [15,17]

Method

Participants

Participants were university staff and students recruited over a two month period (April-June, 2012). Participants were offered bonus credit or the opportunity to go into a prize draw, in return for participation. Participants were randomly allocated to one of four conditions. A total of 204 participants met the inclusion criteria. After screening (see below) data from 108 participants (M_{age} = 22.13, SD = 6.32; 81.5% female) were retained for analysis. These participants had a negative medical history for potential confounds (i.e., no previous history of mTBI, no current psychiatric or neurological diagnosis, and no treatment

[†] Weber and Edwards analysed outcome at the item-level only and did not use a summary score.[13]

from a mental health professional currently or in the past 12 months). Participants were randomly assigned to either the no diagnosis (*n* = 26), concussion (*n* = 31), MHI (*n* = 24), or mTBI group (*n* = 27). The demographic characteristics of our sample by group are shown in Table 1. There was no significant differences between the groups on key demographic variables (see Table 1).

Exclusions. Approximately 10% of participants who were eligible to enrol had incomplete data and were excluded (*n* = 19). Five participants indicated their native language was a language other than English. These participants were retained in the analyses as sufficient English proficiency was assumed on the basis of current student/staff status at an Australian university. Furthermore, the use of the post experimental questionnaire described below assessed participant comprehension of the survey task. Data screening revealed 77 cases met the exclusion criteria: 32 cases were excluded because their score on the Mild Brain Injury Atypical Symptoms Scale (mBIAS; see below) indicated over-reporting of symptoms; 26 cases were excluded for not passing the effort tests (see below); 12 cases were excluded for not passing the knowledge tests (see below); and seven cases were excluded because their qualitative responses indicated they had not understood the task instructions.

Insert Table 1 about here

Measures

Preexperimental questionnaire. The preexperimental questionnaire was used to assess sample demographics (see above), and verify that participants met the inclusion criteria.[‡]

[‡] The inclusion criteria were designed to minimise potential confounds (i.e., no history of previous mTBI, no current neurological or psychiatric impairment, not currently (including during the past 12 months) seeking treatment from a mental health professional).

mTBI Vignette. The mTBI vignette developed by Sullivan, Edmed and Cunningham[23] was used in this study. This vignette depicts a relatively minor MVA that results in personal injury. The injury described in the vignette is consistent with a diagnosis of a mTBI defined according to World Health Organization standards. For this study, the experimental conditions had an additional sentence at the end of the vignette to convey the relevant diagnosis (e.g., "Based on your injury, you were given a diagnosis of a CONCUSSION").

Neurobehavioral Symptom Inventory (NSI).[24] The NSI was used to assess PCS symptoms. This measure has good psychometric properties[25] and it is recommended as a supplemental outcome measure for brain injury research. [21] The NSI has 22-items that assess sensory, somatic/physical, cognitive, and affective/psychological symptoms. The extent of disturbance caused by symptoms is rated on a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*very severe*). A modified instruction was used to elicit symptom expectation six months after injury. Total and cluster scores were obtained using the method described by Kennedy and colleagues. [21] Higher scores on the NSI represent greater symptomatology. A cut-score described by King[26] was used to provide an indication of the clinical significance of NSI total scores.

PTSD Checklist-Civilian (PCL-C).[27] The PCL-C is a 17-item self-report measure designed to assess symptoms of posttraumatic stress. The PCL-C captures the symptoms of PTSD, as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM), fourth edition.[28] The PCL-C is also recommended as a TBI supplemental outcome measure.[29] Participants rated the extent to which they expected symptoms to disturb them over the past two weeks six months after the injury using a 5-point Likert scale from 1 (*not at all*) to 5 (*extremely*). Total scores are obtained by summing item responses, with a possible score ranging from 17-85. The suggested cut-score for identifying clinically relevant PTSD symptoms is 50. [27]

Mild Brain Injury Atypical Symptoms Scale (mBIAS).[30] The mBIAS was used to assess symptoms that are uncommonly reported by mTBI patients. The cut-score described by Cooper and colleagues[30] was used to evaluate total scores. This measure was used to exclude participants who were over reporting or indiscriminately reporting symptoms. Items were embedded with NSI as per Cooper et al.[30] and were presented with the same modified instruction and response format that the NSI and PCL-C employed.

Illness Perception. The timeline and consequences subscales from the Illness Perception Questionnaire-Revised [31] were used in this study. This measure has been used previously to assess illness perception in mTBI.[11] The timeline subscale has six items, three of which are reversed scored. This subscale assesses perceptions about the recovery timeline (e.g., My injury will last a long time [Reverse scored item: My injury will last a short time]). The consequences subscale has 6 items (one reverse scored). This subscale assesses perceptions about broader injury impacts (e.g., My injury will have major consequences). Items are presented on a Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). For this study the word 'illness' was changed to 'injury'. Subscale scores were obtained using the method described by Moss-Morris et al.[31] such that higher scores indicate more negative perceptions.

Undesirability. An item to assess perception of the undesirability of the injury was used given the suggestion that such views may account for differences in expected symptoms.[6] Participants provided a response to the question "How undesirable would you find such an experience?" using a 5-point Likert Scale (1 = *not at all undesirable* to 5 = *extremely undesirable).*

Postexperimental questionnaire. The postexperimental questionnaire was used to assess compliance with instructions and vignette comprehension. This check was undertaken because this study involved reporting expected symptoms that were based on a vignette. Such checks are recommended in malingering studies that use vignettes,[32] and are regarded as important for studies that use experimental designs, such as this one.[33] Three *compliance* questions were used to assess understanding of the instructions: 1) Did you understand the instructions provided in this study? (response: Yes/No); 2) Did you forget to put yourself in the position of the character described in the accident while answering any of the symptom items? (response: Yes/No), and 3) Please briefly explain what you were required to do in this experiment? (response: qualitative, with responses later independently scored by SE and CK). Vignette comprehension was assessed by asking three multiple choice *comprehension* questions: 1) In the story, how long did the character lose consciousness for? 2) In the story, how long did the character stay in hospital? and 3) In the story, what was the character's memory recall like after the accident? Participants were scored as failing the postexperimental questionnaire if they incorrectly answered one or more of the compliance or comprehension questions.

Procedure

All study materials were configured for online administration. Consenting participants first completed the preexperimental questionnaire. Participants were advised to carefully read experimental instructions and were informed that effort would be assessed. Next, participants were randomly allocated to view one of the four vignette conditions via the survey software randomization plugin. Participants in the no diagnosis condition were shown the vignette only, whereas participants in the concussion, MHI and mTBI conditions were shown the vignette plus the relevant additional diagnostic sentence. The vignette exposure time was not controlled; however a pause was induced by requesting a response to the undesirability question, which was presented with the vignette.

Participants proceeded to a second instruction page to prepare them for symptom rating. This page instructed them to rate their expectation of the depicted injury using the IPQ-R timeline and consequences subscales. Participants were then asked to rate the NSI/PCL-C/mBIAS symptoms according to their expectation of what the person in the vignette would experience during a two week period, six months post injury. They were instructed to guess if unsure and were permitted to return to the vignette, as necessary. Three items, constructed as a further "instructional manipulation check,"[33] were also embedded in the NSI/PCL-C/mBIAS. These items varied the wording of one question (e.g., Please select *quite a bit* as your response to this question). Finally, the post experimental questionnaire was administered.

Results

Preliminary analyses

The data were analyzed using PASW Statistics 18. A missing values analysis was undertaken and revealed that there were no variables with more than 2.2% of missing data. Little's MCAR test indicated that the data were missing at random, $\chi^2 = 2276.26$, $p = .628$. Therefore, the missing data were resolved using Expectation-Maximisation algorithms for maximum-likelihood estimation, as recommended by Tabachnick and Fidell.[34] A significance level of 0.05 was used for all analyses, unless otherwise stated. Where multiple statistical comparisons are reported and there is an increase in the probability of Type 1 error, a Bonferroni adjusted alpha to control for the family-wise error rate is presented for readers who wish to apply a more conservative interpretative standard.

Effect of diagnostic terminology on symptoms expected six months post injury

Descriptive statistics for symptom (PCS and PTSD) data by group are shown in Table 2. This Table presents data from the NSI (total and cluster scores) and IPQ-R subscales, consequences and timeline. Applying the NSI total cut-score revealed that between 23 (concussion) and 46 percent of participants (no diagnosis) scored above this cut-off, and no effect of terminology was evident using this criterion, $\chi^2(3)= 4.48$, p=.215.[§] Appyling the PCL-C cut-score revealed that between zero (concussion) and 26 percent of the sample (mTBI) scored at or above the PCL-C criterion; this group comparison was significant, $\chi^2(3)= 8.78$, p=.032.[**]

Further investigations of group differences on expected symptoms by condition were undertaken using Kruskal-Wallis tests because the statistical assumptions for parametric tests were breached.[††] Each of these analyses had one independent variable, group, with four levels (no diagnosis, concussion, MHI, mTBI), and one NSI dependent variable (total score or one of the four NSI subscale scores). These analyses revealed no significant effect of terminology on NSI: total, $H(3)= 6.68$, p=.083, physical, $H(3)= 2.90$, p=.407, cognitive, $H(3)= 7.77$, p=.051, or sensory cluster scores, $H(3)= 2.55$, p=.477; but a significant affective cluster result, $H(3)= 8.30$, p=.040. The latter effect was followed up with Mann-Whitney tests, which revealed that, on average, significantly more affective symptoms were reported by participants in the no term condition compared to the concussion condition, $U = 227.5$, z =

[§] Number and percentage scoring above NSI total cut score (17.5) by group: concussion = 7/31 (23%); MHI = 6/24 (25%); mTBI = 10/27 (37%); no diagnosis = 12/26 (46%).
[**] Number and percentage scoring equal to or above PCL-C total cut score (50) by group: concussion = 0/31 (0%); MHI = 3/24 (13%); mTBI = 7/27 (26%); no diagnosis = 4/26 (15%).
[††] The normality assumption was breached for the NSI total (control, MHI) and all cluster scores, with minor exceptions. The homogeneity of variance assumption was breached for NSI affective and somatic/physical cluster scores, but no other NSI scores. PCL-C data were normally distributed for all conditions except MHI; however, Levene's statistic indicated a breach of homogeneity of variance, F (3,104) = 5.78, p = .001.

-2.85, p= .004 (2-tailed), r = -.27, but no other significant differences were found. Group comparisons revealed a significant effect of terminology on expected PTSD symptoms, H(3) = 10.89, p = .012. Post-hoc Mann-Whitney tests revealed that the frequency of expected PTSD symptoms was significantly higher in the no diagnosis condition compared to the concussion condition, U = 202.00, z = -3.22, p = .001 (2-tailed), r = -.31, and when mTBI was compared to concussion, U = 277.00, z = -2.21, p= .027 (2-tailed), r = -.21, but no other significant differences were found. With a more conservative alpha (p<.008), the follow up tests for affective PCS and PTSD symptoms (concussion < no diagnosis) remained significant.

Insert Table 2 about here

Effect of diagnostic terminology on illness perception (consequences, recovery timeline, and undesirability)

Descriptive statistics and group comparisons for illness perception are also shown in Table 2. Non-parametric statistics were used because of breached statistical assumptions.[‡‡] Kruskal-Wallis comparisons revealed differences between conditions for both IPQ-R subscales, timeline, H(3) = 11.41, p= .010, and consequences, H(3) = 8.53, p=.036. Follow up Mann-Whitney tests showed that, on average, participants expected a significantly longer recovery period in the no diagnosis condition compared to concussion, U = 227.5, z = -2.84, p= .004 (2-tailed), r = -.27; and for mTBI compared to concussion, U = 249.00, z = -2.69, p= .006 (2-tailed), r =.-.26. Similarly, on average participants expected more severe consequences in the no diagnosis condition compared to concussion, U = 246.00, z = -2.53,

‡‡ The IPQ-R and undesirability data breached the homogeneity of variance and normality assumptions for parametric tests (both subscales breached the variance assumption and the timeline subscale was not normally distributed in the MHI and mTBI conditions).

p= .011 (2-tailed), *r* = -.24; and for mTBI compared to concussion, *U* = 282.50, *z* = -2.14, *p*= .033 (2-tailed), *r* = -.21. In relation to term effects on perceived undesirability, the omnibus Kruskal-Wallis test was significant, *H*(3)= 8.28, *p* =.040, with follow up Mann-Whitney tests revealing that, on average, mTBI was perceived as significantly more undesirable than concussion, *U* = 252.00, *z* = -2.76, *p*= .006 (2-tailed), *r* = -.27, or MHI, *U* = 212.50, *z* = -2.22, *p*= .027 (2-tailed), *r* = -.21. No other significant IPQ-R or undesirability effects were found. With the more conservative alpha for follow up tests ($p < .008$), significant effects remained for the IPQ-R timeline and undesirability comparisons, respectively (mTBI worse than concussion).

All analyses were also conducted after removing outliers to determine if the results would change. There were no extreme outliers (i.e., greater than 3 *SD*). When outliers greater than 2 standard deviations were removed, only one result changed from being non-significant to significant after applying the alpha adjustment for multiple comparisons. Post-hoc Mann Whitney tests comparing the frequency of expected PTSD symptoms revealed that participants expected significantly more PTSD symptoms in the no diagnosis condition than the MHI condition, *U* = 122.00, *z* = -3.07, *p*= .002 (2-tailed).

Discussion

The purpose of this study was to determine if, compared to a vignette-exposure control condition, the vignette-exposure-plus-diagnosis conditions produced different expected PCS, PTSD symptoms, and other perceived injury outcomes. We hypothesized that our non-clinical sample would: a) associate the diagnostic term, mTBI, with worse outcomes than other terms (concussion or MHI); b) perceive MHI as worse than concussion, and; c) expect worse outcomes for all of these terms, compared to a control condition (no diagnosis).

The findings suggest that some but not all outcomes were susceptible to differences in terminology; therefore, only some of the hypotheses were supported. When differences were identified, however, a relatively consistent pattern emerged, such that the two pairs that were most likely to differ from each other were: the no diagnosis and concussion conditions (no diagnosis worse than concussion), and the mTBI and concussion conditions (mTBI worse than concussion). Both the no diagnosis and mTBI groups, which did not differ from each other, produced the worst expectations. These results may suggest that an unlabeled injury, or an injury that is labeled mTBI, is considered worse than concussion; or, that concussion is considered less negative than the relevant comparators (no diagnosis and mTBI). The idea that concussion may be viewed as having significantly less serious consequences than mTBI is consistent with previous research that has shown that this term is perceived as less "alarming" than terms that might be used interchangeably with it.[14] That concussion was viewed as less serious than an unlabelled/undiagnosed injury is also plausible if, as has been argued, concussion is associated with positive recovery expectations,[18] whereas the unlabelled injury may have been hard for participants to characterize. In any case, the statistically significant differences that we identified were: a) typically associated with small to medium effects for all outcome types (symptoms and illness perception), although effects were not uniform across all subscales/scores, and; b) with a few exceptions, would still be considered significant against a more conservative alpha.

It should be noted that group effects on the PCS measure were examined using NSI total and cluster scores. It has been suggested that NSI subscale effects should be explored so as not to obscure important trends[35] and that, because the research diagnostic criteria for PCS identify symptoms in clusters, such comparisons are informative. As noted above, however, most NSI symptoms scores (total and subscales) did not differ across groups, even though across these groups approximately one quarter to one half of the sample exceeded a PCS symptom cut-off. The somewhat low level of expected PCS symptom endorsement in this study suggests that this sample responded appropriately to an injury of this severity almost six months later, where the clinical expectation is for there to be no permanent disability for the majority of patients. Taken together these findings suggest that PCS symptom expectation is robust to variation in terms, a finding that is consistent with Weber and Edwards; [13] with the caveat that affective symptoms are less likely to be expected following an injury labeled concussion than the same injury, unlabeled/undiagnosed. In terms of PTSD symptoms, none of the participants who received a diagnosis of concussion met the PCL-C criterion for PTSD symptoms, whereas this criterion was met by just over a quarter of the mTBI sample. In general, the proportion of the sample that met the PTSD clinical cut-off (a maximum of 25% of the mTBI group) was less than the proportion who met the PCS clinical cut-off (a minimum of approximately 25% of the concussion group). Where significant group differences on PTSD symptoms emerged, relative to concussion (the lowest scoring group) the highest scoring groups were: mTBI and no diagnosis. The finding that mTBI was the group with the highest proportion of 'cases' might be a product of terminology overlap (explicit trauma reference) or, the perception that the accident could give rise to both conditions.[36,37]

The finding that poorer outcomes (consequences and timeline, and to a lesser extent perceived undesirability) and greater PTSD symptoms were expected of an injury labeled mTBI compared to concussion is consistent with our hypothesis; however, we also expected differences between the mTBI and MHI conditions, which were not found. The diagnostic term that was least able to be differentiated from the others was MHI. Only one comparison with this term yielded a significant group difference (mTBI was rated as more undesirable than MHI, small to medium effect).

An unexpected finding, contrary to our hypotheses, was that in some circumstances the no diagnosis condition produced worse expected outcomes than a condition with a diagnosis (i.e., concussion or mTBI). We expected that, compared to no diagnosis, the addition of a diagnostic term would activate negative stereotypes, resulting in worse injury expectations. One interpretation of our findings is that adding the term, concussion, provided a context for responding that reduced the negative attributions that were otherwise elicited; perhaps, in the absence of this qualifier. This finding may indicate that in some cases, the diagnosis *reduced* negative expectations; a finding that may accord with suggestions that providing education to patients post mTBI can be beneficial.[38] Two of the diagnostic terms that we studied included injury severity specifiers (ie mild or minor respectively), and as stated previously concussion connotes a less alarming injury.[14] The absence of these qualifiers may have made it more difficult for participants to evaluate the injury severity, recognize the injury type, and apply relevant heuristics to guide responding. For example, although PTSD symptoms were relatively strongly endorsed in the unlabelled condition and, in clinical terms, only 15% of this group met the clinical cut-off, it is possible that participants' attention was focused on the fact that traffic accidents can be life-threatening and lead to strong emotional reactions. That is, even though we depicted a relatively minor accident, we speculate that, in the absence of a diagnosis to focus responding, a higher than expected level of pathology was endorsed by the no diagnosis participants; however we recommend cautious interpretation of our findings until further studies are able to replicate effects.

This study has several limitations. First, we cannot be sure that participants' expectations were only influenced by our vignette and associated diagnostic terms. Second, to investigate whether the manipulation of terminology influenced injury perception and expectation, we utilized a non-clinical sample to remove the potential confound of preexisting expectations/perceptions. As such, the extent to which these results generalize to a clinical sample is unknown; this study does not tell us whether patients respond differently to diagnostic terms. This sample was also comprised mostly of female university students. Although the gender mix of each group was not different, the data are predominantly a reflection of women's view of the likely injury outcome. The inclusion of university students and staff who are typically more educated and come from higher socioeconomic backgrounds than the general population may also limit the generalizability of these findings.

In addition to these sampling limitations, this study is limited by a number of factors that relate to the diagnostic terminology used in this study and other methodological factors. For example, we assessed expectations of the longer term effects of mTBI (six months post injury), including PCS. This timeframe should be borne in mind when interpreting the results; it is possible that individuals would expect different, possibly more negative outcomes of a less chronic injury. This study did not explicitly measure positive expectations for recovery; although participants could choose *not* to endorse symptoms, and some IPQ-R items prompted expectations of a quick return to function, such questions could extend this research. This study did not examine all of the the terms that may be used interchangeably with mTBI; findings do not relate to terms that were not examined in this study (e.g., mild head injury or cerebral concussion).[39] In addition, this study examined the effect of these terms in relative isolation, using a simulation design. The extent to which individual's receive a formal diagnosis following mTBI is itself variable, not only because treatment seeking for mTBI is inconsistent,[40] but also because the diagnostic experience within settings may vary (i.e., patients may not be diagnosed or recall the diagnosis, mixed terminology may be used by different staff, and the diagnosis may come in the form of, or be accompanied by, other information including written discharge advice). Further, the use of a simulation design may have underestimated the potency of a diagnosis given in a genuine clinical situation; or, because this context was not fully simulated (e.g., participants were not given the opportunity to ask questions) effects may have been overestimated. It is important to reiterate that the expectations of people who experience mTBI may be shaped by myriad factors that alter preinjury and peri-injury perceptions. These factors include, but are not limited to, prior experience, patient education, and the clinical context itself, and this study examined the effect of one factor only on such perceptions.

In conclusion, this study shows that terminology affects several important injury-related attributes, but that the expectation of PCS symptoms is relatively unchanged by diagnostic terminology. The major implication of this study is that it provides empirical evidence of the effect of using varied terms to describe mTBI on a factor that has been shown by others to affect patient outcome post mTBI.[41] By demonstrating that uninjured individuals perceive negative consequences of mTBI, and that these perceptions can be evoked by imagining an injury, this study provides indirect support for the models of poor mTBI outcome that identify cognitive factors as potential contributors.[41] At present multiple terms are used interchangeably by researchers and clinicians to describe mTBI, despite the concerns around the ambiguity that this creates for research[42,43] and recent calls to adopt uniform terminology.[44] We acknowledge that the choice of term is complex, and that clinicians are already attempting to manage the psychological injury response through their choice of term.[14] This study draws out some potential implications of this variability on clinically relevant factors. Given the imminent release of DSM-5[45,46] and the opportunity to review terminology that this might provide, this study takes an empirical approach to understanding the implications of using specific terms on factors that may contribute to mTBI outcome.

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Table 1

Participant Demographic Characteristics in Each Experimental Condition and the Statistical Significance of Cross-Condition Comparisons.

	Experimental condition				
	Concussion (*n* = 31)	Minor Head Injury (*n* = 24)	Mild Traumatic Brain Injury (*n* = 27)	No Diagnosis (*n* = 26)	*p*
Age (in years):					
M	21.16	24.46	20.33	23.00	.226
SD	5.03	8.41	2.77	7.53	
Gender:					
Male	12.9%	29.2%	25.9%	7.7%	.142
Female	87.1%	70.8%	74.1%	92.3%	
Ethnicity:					
Caucasian	90.3%	87.5%	88.9%	76.9%	.593
Other:	9.7%	12.5%	11.1%	23.1%	
Dominant Language:					
English	96.8%	95.8%	92.6%	92.3%	.550
Other	3.2%	4.2%	7.4%	7.7%	
Years of Education					
M	13.74	14.69	13.93	13.50	.190
SD	1.77	2.13	1.52	1.32	
Personal knowledge of mTBI[1]:					
No	32.3%	45.8%	55.6%	57.7%	.195
Yes	67.7%	54.2%	44.4%	42.3%	
Type of recovery:					
- With poor recovery	76.2%	53.8%	58.3%	63.6%	.414
- With good recovery	14.3%	30.8%	8.3%	9.1%	
- Uncertain	9.5%	15.4%	33.3%	27.3%	

Notes: *N* = 267. Cross-condition comparisons were performed using Kruskal-Wallis tests for continuous variables and Chi-square tests for categorical tests. Significance evaluated at *p* =.05 (2-tailed). 1 = Personal knowledge of mTBI assessed participants prior personal experience with mTBI (Prompt: Do you know someone personally that has sustained a mTBI?. If a participant answered Yes they were then asked about the person's type of recovery (prompt: "what sort of recovery did the person have 6 months after the mTBI?)mTBI = Mild traumatic brain injury.

Table 2

Number of Expected Postconcussion Syndrome and PTSD Symptoms and Consequences Expected Six Months Post Injury as a Function of Diagnostic Terminology.

	Terminology used to describe injury							
	Concussion (*n* = 31)		Minor Head Injury (*n* = 24)		Mild Traumatic Brain Injury (*n* = 27)		No Diagnosis (*n* = 26)	
	%	*M (SD)*	%	*M (SD)*	%	*M (SD)*	%	*M (SD)*
PCS Symptoms								
Poor concentration, can't pay attention, easily distracted	38.7		45.8		51.9		57.7	
Difficulty making decisions	32.3		50		55.6		53.8	
Forgetfulness, can't remember things	51.6		41.7		59.3		69.2	
Fatigue, loss of energy, getting tired easily	38.7		50		59.3		53.8	
Slowed thinking, difficulty getting organized, can't finish things	32.3		33.3		48.1		53.8	
NSI-Cognitive		2.32(2.64)		3.08 (3.48)		3.96 (3.30)		4.65(4.12)
Feeling dizzy	35.5		41.7		44.4		53.8	
Poor coordination, clumsy	35.5		29.2		37.0		38.5	

Vision problems, blurring, trouble seeing	25.8		25		33.3		34.6	
Nausea	22.6		25		25.9		3.8	
Loss of balance	25.8		25		33.3		38.5	
Loss of appetite or increased appetite	22.6		33.3		37		38.5	
NSI-Physical		1.97 (2.54)		2.17 (3.07)		2.59 (2.74)		3.50 (4.26)
Headaches	77.4		66.7		66.7		80.8	
Sensitivity to light	35.5		41.7		29.6		38.5	
Hearing difficulty	6.5		8.3		18.5		15.4	
Sensitivity to noise	41.9		45.8		48.1		53.8	
Numbness or tingling on parts of my body	25.8		29.2		33.2		34.6	
Change in taste and/or smell	3.2		12.5		7.4		19.2	
Difficulty falling or staying asleep	41.9		50		59.3		65.4	
NSI-Sensory		3.16(2.68)		3.75(3.86)		4.11 (4.00)		5.00(4.30)
Feeling anxious or tense	71		70.8		74.1		96.2	
Feeling depressed or sad	22.6		58.3		48.1		53.8	
Irritability, easily annoyed	45.2		54.2		51.9		57.7	
Poor frustration tolerance, feeling easily overwhelmed by things	48.4		50		70.4		65.5	
NSI-Affective		2.42(2.19) [a*]		3.21(2.96)		4.48(4.07)		4.62(3.07) [a]
NSI Total		9.87 (9.04)		12.21		15.15 (12.64)		17.77 (14.16)

		(12.80)		
Illness perception				
IPQ-R timeline	11.32 (2.04)^{a,b}	12.17 (3.42)	14.78 (5.22)^{b*}	14.00 (4.50)^{a*}
IPQ-R consequences	11.74 (2.93)^{a,b}	12.21 (3.66)	14.11 (4.41)^{b}	14.69 (4.82)^{a}
PTSD symptoms & undesirability				
PCL-C Total	28.42 (7.88)^{ab}	32.04 (10.53)	37.96 (15.73)^{b}	37.81 (11.24)^{a*}
Undesirability	3.61 (.88)^{a*}	3.71 (.86)^{b}	4.19 (1.00)^{ab}	3.88 (.99)

Note: N = 108. NSI = Neurobehavioral Symptom Inventory; NSI-Cognitive = NSI cognitive subscale; NSI-Physical = NSI Physical subscale; NSI-affective = NSI Affective subscale; NSI subscale scores were calculated as per Kennedy.[47] NSI ratings were made on 5-point Likert scale ranging from 0 to 4 and scale items were summed to produce subscales and total scores. Higher NSI scores indicate greater symptomatology. IPQ-R = Illness Perception Questionnaire Revised. IPQ-R items were rated on a 5-point Likert scale, and items were summed to produce subscale scores. Higher IPQ-R scores indicate more negative perception. PCL-C = PTSD checklist-Civilian. Higher PCL-C scores indicate greater PTSD symptomatology. Undesirability was rated on a 5-point Likert scale; higher scores represent greater undesirability. ^{ab}Conditions that share the same superscripts were statistically different from each other in follow up Mann-Whitney tests ($p < .05$). Asterisked follow up comparisons are those that remained statistically significant with a conservative Bonferroni corrected alpha ($p < .008$); only one condition of the comparison pair is marked. % = Percentage of participants who endorsed the item at a level greater than zero (not at all).