Assessing Negative Attributions after Brain Injury

with the Ambiguous Intentions Hostility Questionnaire

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Objectives: ~~A~~ 1) to explore the construct validity of the Ambiguous Intentions Hostility Questionnaire (AIHQ) in participants with TBI (i.e., confirm negative attributions are associated with anger and aggression); and 2) use the AIHQ to examine negative attribution differences between participants with and without TBI.

Setting: Two rehabilitation hospitals.

Participants: Eighty-five adults with TBI and 86 healthy controls (HC).

Design: Cross-sectional survey.

Main Measures: The AIHQ, a measure of negative attributions (intent, hostility, and blame), anger, and aggressive responses to hypothetical scenarios.

Results: Attributions were significantly correlated with anticipated anger and aggressive responses to AIHQ scenarios. Compared to HC's, participants with TBI reported stronger negative attributions ($p \leq .001$), anger ($p = .021$), and aggressive responses ($p = .002$) to the scenararios.

Conclusion: Negative attributions were associated with anger and aggression responses, demonstrating construct validity of the AIHQ in the TBI population. Participants with TBI judged others' behaviors more severely than HC's, similar to prior research using a different attribution measure. The AIHQ has promise as a practical instrument for assessing negative attributions after TBI.

Key Words: intent, hostility, blame, attributions, anger, brain injury.

Word count: 3449

INTRODUCTION

Episodes of anger and aggression often become more frequent or extreme after a traumatic brain injury (TBI).[1] A recent study of participants with chronic TBI and healthy controls found that the prevalence rates of "above average" anger and verbal aggression were nearly double in participants with TBI (39% and 41%, respectively) compared to uninjured peers.[1] This same study reported above average physical aggression in 26% of the TBI group. Reasons for anger and aggression after TBI may vary depending on the person and their injury, mandating a case-by-case approach to understanding and treating the problem. Identifying mechanisms that underlie post-TBI anger and aggression can facilitate identification of the most appropriate and effective treatment approaches.

To better understand anger and aggression mechanisms after TBI, recent research tested the "attribution-emotion" theory in the TBI population.[2,3] This theory states that attributions or judgments that are made about others' behaviors influence one's emotional response to those behaviors.[4-6] Negative attributions(e.g., intent, hostility, or blame) have been associated with anger and aggression in non-clinical and clinical populations without TBI.[5,7-10] Recent research in the TBI population[2] confirms that the attribution-emotion connection remains intact in the TBI population, showing that the more intentional, hostile, or blameworthy participants with TBI judged others' behaviors to be, the greater their anger response.

Notably, some people are prone to making attributions that are disproportionate to the circumstance and/or more severe than the norm. This is referred to as "negative attribution bias." In non-TBI samples, this tendency has been linked to cognitive distortions, paranoia, and poor social inferencing skills.[5,7-9,11] Given that distorted thoughts and impaired social inferencing are common TBI sequelae[12-16], it was logical to examine negative attribution bias in the TBI population. As expected, a study comparing participants with and without TBI found that the former made more extreme judgments of intent, hostility, and blame compared to those without TBI,[3] suggesting that persons with TBI may be prone to negative attribution bias.[3] A more recent multisite project with a larger sample (n=210)

provided further validation supporting the attribution-emotion theory and negative attribution bias in the TBI population.

The above studies provide compelling evidence that negative attributions are a concern after TBI. This underscores the importance of more research in this area, as well as the need to incorporate negative attribution assessments into clinical practice, especially in patients who present with anger and aggression. Clinical assessments could help clinicians discern the most promising treatment plan. Unfortunately, the Epps Scenarios[5] is the only negative attribution measure described in the TBI population to date, and it has several practical limitations which may restrict its broad adoption for clinical and research use. Limitations include length of the individual scenarios and the overall measure, which often takes between 45 and 60 minutes to administer, and the complexity scenarios, which requires sufficient working memory. Since impaired working memory is a common problem after TBI[17,18], this could exclude its use in patients with more severe cognitive problems. A final limitation is that the scenarios do not measure how the person would respond to the event, which limits our understanding of the impact of negative attributions on behavior.

Notably, there is another assessment option for negative attributions: the Ambiguous Intentions Hostility Questionnaire (AIHQ).[9] The AIHQ is widely used in the non-TBI literature, particularly with the schizophrenia population, and was the recommended measure for evaluating negative attributions by a panel of experts who were part of the Social Cognition Psychometric Evaluation (SCOPE) study.[19] The AIHQ[9] consists of vignettes describing intentional, ambiguous, or accidental actions that participants are asked to make judgments about and report their anger and anticipated response to the situation. In terms of practicality, the AIHQ has fewer and less complex scenarios than the Epps scenarios. In addition, several studies suggest the ambiguous scenarios alone may provide sufficient information since biases and characteristics such as paranoia can influence how one interprets unclear actions. [9,19] Consquently, they are believed to be the best representation of negative attribution bias.

The compelling support and use of the AIHQ in non-TBI populations, in addition to its practical features, sparks interest regarding its potential for evaluating negative attributions in people with TBI. Objectives of the current study were twofold: 1) Examine the construct validity of the AIHQ in the TBI population with regard to associations of negative attributions (intent, hostility, and blame) with anger and aggression; and 2) use the AIHQ to search for attribution differences between participants with and without TBI. We anticipated the AIHQ would uphold the attribution-emotion theory, and we further hypothesized that participants with TBI would perceive others' actions as more intentional, hostile, and blameworthy than would their uninjured counterparts. Since time constraints for administration are often a barrier to utility, both study objectives were not only explored for the full AIHQ measure, but also examined and compared to ambiguous-only scenarios.

METHODS

Participants

The current study was part of a larger investigation of negative attributions (n=210) conducted at two brain injury rehabilitation sites: one in Indiana and one in Texas. This study was approved by ethics review boards at both sites, and all participants provided consent prior to study participation. Once participants were enrolled and completed the main outcome measures for the larger study, participants were given the opportunity to complete another assessment (AIHQ) for an additional small stipend. It was optional because it was not the main focus of the larger study, and it was at the end of a long (~3 hour) study visit. Twenty participants with TBI and 19 HC participants in the larger study opted out of completing an additional measure. Only participants who completed the AIHQ are included herein: 85 participants with TBI and 86 healthy controls (HC).

Recruitment occurred through letters sent to past and current patients at the rehabilitation centers and participants in approved research databases and registries. In Indiana, recruitment also occurred through local support groups and online newsletter ads affiliated with our healthcare system. Peer

controls (frequency matched on age and gender) were recruited through the patients (i.e., friend or family member of the participant with TBI), online ads/ social media, flyers around the hospitals and local community clubs and organizations.

Consistent with study inclusion criteria, participants with TBI had injury severities that ranged from complicated mild to severe TBI[20] (i.e., Glasgow Coma Score <13 at time of injury, post-traumatic amnesia ≥24 hours, loss of consciousness ≥30 minutes, or CT scan showing intracranial abnormality) and were a minimum of 6 months post-injury. All participants were free of neurological disorder or injury (aside from a TBI), major psychiatric disorder that could affect social cognition (e.g. schizophrenia; bipolar disorder), and developmental disability (e.g. autism). All participants were 18 years or older with adequate expressive language and comprehension (determined by Discourse Comprehension Test (DCT))[21] at screening, and spoke fluent English. See Tables 1 and 2 for descriptive statistics of demographics and injury information for the sample.

The sample size for the current study was based on the overarching study that had a wider scope of interest, requiring 210 participants (105 TBI and 105 peer controls) to examine up to 21 variables in a multiple regression model using the rule of thumb of 10 participants per variable in the model. The AIHQ was an optional assessment at the end of a long visit, and 81% of participants opted to take it, resulting in a sample size of n=85 TBI and n=86 peer controls for the current study.

<Table 1 and Table 2 here>

Measures

Ambiguous Intentions Hostility Questionnaire (AIHQ)[9]: The AIHQ is comprised of 3 types of hypothetical scenarios describing characters' behaviors as either 1) intentional (clearly purposeful actions), 2) ambiguous (n=5), or 3) accidental (n=5), for a total of 15 written vignettes. After being presented with each vignette, participants are asked questions to assess perceived hostility and intent,

how angry they felt, how much they blamed the character, and how aggressively they would respond. Participants used Likert scales to answer questions about Intent, Anger, and Blame. All responses were given on a 5-point scale except Intent, which was a 6-point range. Hostility and Aggression questions were open-ended and scored on Likert scales by two independent raters unaware of subject group. On average, the AIHQ took approximately 20 minutes to administer. (See AIHQ supplemental digital content for more detail about this measure). The ICCs for the two raters were 0.80 for hostile attributions and 0.73 for aggressive behavior, indicating good (0.60 to 0.74) to excellent (0.75 to 1.00) agreement.[22] Thus, the two ratings were averaged. Next, scale scores were created for each scenario type by calculating the mean of the 5 ratings within each scenario for each of the 5 scales. Finally, the mean score across all scenario types was calculated for each scale. Internal reliability (Cronbach's $\propto$) in this sample of participants with TBI was .76, .57, .83, .86, and .75, for intent, hostility, blame, anger and aggression scales, respectively. Psychometric testing in other populations indicates adequate reliability and validity. [9,19,23,24]

Procedures

Demographic and medical history information was obtained by interview with participants and later confirmed via medical records. Participants were administered a Discourse Comprehension Test to determine if they met the reading comprehension criterion (75% correct).[21] Participants who met the reading comprehension and other inclusion criteria were administered a battery of measures as part of the larger study. Those who opted to complete the AIHQ did so at the end of the study visit.

DATA ANALYSES

All the data analyses were conducted using SAS 9.4 (Cary, NC). Comparisons between TBI and HC groups for demographic variables were made using two-sample t-tests or Chi-square tests. Spearman's correlations were calculated to determine the strength and direction of associations between all the scenarios of AIHQ intent, hostility and blame scales with respective scenarios of AIHQ anger and

aggression. Spearman's was used to avoid requiring linearity. Comparisons were also made between TBI and HC groups using two-sample t-tests for mean ambiguous, intentional, accidental scenarios and total score of each AIHQ scale (intent, hostility, blame, aggression and anger). For each AIHQ scale, the ambiguous score was correlated with the total scale score. Correlations were classified as very weak (0.00 – 0.19), weak (0.20 – 0.39), moderate (0.40 – 0.59), strong (0.60 – 0.79), very strong (0.80 – 1.00).[25] The Hochberg method was used to compute adjusted p-values within scales.[26]

RESULTS:

Demographic differences between TBI and HC groups

The participants in the TBI group had significantly lower education levels than the participants in the peer control group. Also, the TBI group had a significantly lower proportion of married persons and a higher proportion of single and divorced participants (Table 1).

Relations of AIHQ intentionality, hostility and blame with anger and aggressive responses

Attributions of intent were significantly moderately correlated with their respective anticipated anger responses, regardless if the attribution and emotion scores were calculated from the complete set of AIHQ scenarios (ambiguous, intentional and accidental) or ambiguous-only. A weak correlation was identified between attributions of hostility and respective anger responses when calculated from the full set of scenarios, whereas significant moderate associations were found when calculated from the ambiguous-only scenarios. For blame attributions, scores were significantly strongly correlated with anger responses that were calculated from all scenarios and from ambiguous-only scenarios. With regard to relations between attributions (intent, hostility and blame) and respective anticipated aggressive behavioral responses to the AIHQ scenarios, all associations were significant for the complete set of scenarios or ambiguous-only. However, associations were of moderate strength for the complete set of scenarios, compared to weak associations for ambiguous-only scenarios. (Table 3).

Group differences in AIHQ scenarios

When scores were averaged from all the scenarios (ambiguous, intentional and accidental), ratings were significantly higher for participants with TBI than HCs for intent (p=.001), hostility (p<.001), and blameworthiness (p<.001), as well as feelings of anger (p=.021) and anticipated aggressive responses (p=.002). (Table 4). This same pattern was observed when group comparisons were made examining scores that were averaged from just the ambiguous-only scenarios. These comparisons which also included accidental and intentional scenarios are reported in Table 4.

Relations of AIHQ ambiguous-only scenarios to All AIHQ scenarios

Scores from the complete set of AIHQ scenarios were either very strongly or strongly correlated with respective ambiguous-only scenario scores. (Table 5).

DISCUSSION

Previous research has shown that people with TBI judge others' behavior as more intentional, hostile and blameworthy than do persons without TBI, and these attributions are associated with their self-reported anticipated anger responses to the situational events in question.[2,3] Prior research used the Epps scenarios to assess negative attributions, but these scenarios have limited practicality for clinical use. Compared to the Epps scenarios, the AIHQ has fewer scenarios (15 versus 21), simpler scenarios (1 to 2 sentences versus a paragraph) and takes less time to administer (~20 minutes versus 45-60 minutes). The AIHQ has demonstrated utility in other medical populations, including schizophrenia; the current study explored potential utility with persons with TBI.

The first goal of the current study was to examine the construct validity of the AIHQ in the TBI population by examining how well it upheld the attribution-emotion theory. This theory proposes that emotional responses to events are related to the negative attributions made about that situation.[4-6] This relation was supported in our past research using a different instrument,[2,3] and the current study replicated this work using the AIHQ, showing that stronger attributions of intent, hostility, and blame were associated with stronger anger responses. Thus, the attribution-emotion theory was supported in

the current study using the AIHQ in our TBI sample and therefore provides early evidence of the construct validity of this measure in the TBI population. While relations between attributions and anger were all significant, their strength did vary either based on type of attribution and/ or based on full set of scenarios versus ambiguous-only. Attribution-anger relations were predominantly of moderate strength for intent and strong for blame, regardless if the complete set of scenarios or ambiguous-only scenarios were used. The strength of the hostile attribution relation with anger was stronger for ambiguous only scenarios (moderate) than when the complete set of scenarios was used (weak). In addition, the current study was unique in investigating self-reported anticipated aggressive behavioral responses to the situation. This is another advantage of the AIHQ over the Epps scenarios measure; the latter does not include a question on anticipated behavioral responses. Self-reported aggressive responses were also significantly correlated with all attribution types, ranging from weak to moderate; however, the relations were stronger for the full set of scenarios.

The current study also examined group differences in attributions and provided further support for negative attribution bias in persons with TBI relative to HCs. As hypothesized, results from the current study found that participants with TBI made more extreme attributions about others' intent, hostility and blameworthiness, compared to HCs, as well as higher self-reported anger responses to the situation. This is consistent with findings from our past studies.[2,3] Results further showed that persons with TBI anticipated they would have more aggressive responses compared to HCs. Although the direction of this relation cannot be determined from the study design, these findings do illustrate a link between attributions and self-reported anticipated behaviors.

Of note, group differences for attributions, anger and aggressive responses were detected regardless if they were derived from the complete set of scenarios (n=15) or just the ambiguous scenarios (n=5). Identifying these differences with the ambiguous-only scenarios was a critical finding since theoretically, it is the ambiguous scenarios that are believed to be the biggest driver in detecting

attribution biases. When the intent behind one's actions is unclear (ambiguous), a person can either decide to give others the benefit of the doubt or assume the worst; persons with attribution biases are more likely to lean towards the latter. Finding group differences with ambiguous scenarios provides further support for negative attribution biases in the TBI population. The next step would be for future research to begin to explore reasons or factors that might make persons with TBI more prone to these biases.

In addition to examining outcomes with the complete set and ambiguous-only scenarios, differences were also explored with the other scenario types - accidential and intentional. In response to accidental scenarios, despite ratings being relatively low, people with TBI still reported more negative attributions, anger and aggressive behaviors compared to HCs. This means some responses of people with TBI are likely to be outside the expected norm and disproportionate to the circumstance. In contrast, both groups had similar reactions to scenarios portraying obvious mal-intent behind the character's actions. It is possible that intentional behaviors are so extreme and clear cut that there is less variability in how they can be interpreted.

Finally, we examined how similarly the AIHQ functions as a full scale (all 15 scenarios) compared to ambiguous-only scenarios (5). Strengths of associations between full set of scenarios and ambiguous-only outcomes were very strong for intent, hostility, blame, and anger. Aggressive behavioral responses for the full scale were strongly associated with the ambiguous-only responses for aggressive behavior. This suggests that outcomes may be similar if just ambiguous-only scenarios are administered, and provides preliminary support that administering the full scale might not be necessary to glean important information. This would have further practical utility, creating a briefer assessment to be used in clinical settings. The time difference in administration is cut in half for the ambiguous-only scenarios (20 minutes reduced to 10). If this same principle of using ambiguous-only scenarios were applied to the Epps measure, the AIHQ ambiguous-only administration would still have the practical

advantage of having fewer questions (5 vs 7) and shorter, less complex scenarios (1-2 sentences vs a paragraph), resulting in shorter administration time.

LIMITATIONS

While the psychometric properties of the AIHQ have been well-established in the schizophrenia population, further examination is necessary in the TBI population, and as such, the results of the current study should be interpreted with caution. This study provides initial evidence of good inter-rater reliability, and internal consistency was in the acceptable-to-good range, except for the *hostility* scale. It is possible that the internal consistency of the hostility scale was in the lower range due to being a rater-scored item of an open-ended response. However, it is also notable that the hostility scale, along with intent and blame scales, significantly correlated with anger and aggression responses consistent with theoretical expectations, and revealed differences between TBI and non-TBI participants.

The AIHQ was an optional measure offered at the end of a long study visit and consequently, there may be some reflection of bias in which participants agreed to complete the additional measure. Scenarios were hypothetical, and responses regarding anger and aggressive behavior were subjective reports of how they believed they would feel and respond in the situation, which may not accurately reflect their actual responses in real life. Also, because participants were asked to verbalize their response to research assistants, fear of examiner judgment could have altered how they responded.

Due to the preliminary nature of the current study, we did not control for potential covariates, including education, socioeconomic status, substance abuse, depression, anxiety, or executive funcitioning. These factors should be examined and controlled for as appropriate in future studies, but also examined with respect to identifying potential risk factors for negative attribution tendencies after TBI. Finally, although the information gleaned from ambiguous scenarios was comparable to that from the full scenario outcomes, they were all administered together. It is unknown how or if the responses to

ambiguous scenarios would change if administered separately from the rest of the measure. Future studies should investigate if administering these scenarios in isolation of the full set makes a difference.

CONCLUSION

Outcomes using the AIHQ supported the attribution-emotion theory and replicated findings illustrating that participants with TBI, on average, judge others' behaviors more negatively than do their uninjured counterparts. This was the first study in TBI to establish a link between attributions and anticipated aggression of behavioral response. Findings suggest that inappropropriate actions are likely to follow skewed interpretations that persons with TBI make about others' behavior. Although more work is needed to fully examine the the AIHQ's psychometric properties in the TBI population, findings from this preliminary study provide initial evidence for the construct validity of the AIHQ, and suggest that it may be a brief, practical means of assessing negative attributions in the TBI population. Further, it appears that scores from the ambiguous-only scenarios are comparable to thoses from the full scale, which can further reduce the administration time. In sum, this study yields important discoveries that may facilitate future research and clinical application in the field of negative attributions in people with TBI, with potential relevance to the treatment of anger and aggression.

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Table 1: Demographics. *P-value obtained from chi-square test. **P-value obtained from Fishers' exact test.

Variables	TBI group N = 85	HC group N = 86	P-value
Age [Mean (SD)]	40.0 (13.3)	40.6 (15.1)	0.794
Education level [Mean (SD)]	14.1 (2.1)	15.1 (2.7)	0.009
Gender, n (%)			0.588*
Female	38 (44.7%)	42 (48.8%)	
Male	47 (55.3%)	44 (51.2%)	
Race, n (%)			0.944**
Asian	1 (1.2%)	0	
Black	17 (20%)	19 (22.1%)	

Native American	1 (1.2%)	1 (1.2%)	
Other	2 (2.4%)	1 (1.2%)	
White	64 (75.3%)	65 (75.6%)	
Marital status, n (%)			0.027
Married	25 (29.4%)	44 (51.2%)	
Domestic partner	2 (2.4%)	2 (2.3%)	
Relationship	11 (12.9%)	7 (8.1%)	
Single	31 (36.5%)	27 (31.4%)	
Divorced	16 (18.8%)	6 (7.0%)	
Ethnicity, n (%)			0.193
Not Hispanic or Latino	74 (87.1%)	80 (93.0%)	
Hispanic or Latino	11 (12.9%)	6 (7.0%)	
Current income, n (%)			
$0 - $9,999	34 (40%)	19 (22.1%)	
$10,000 - $19,999	17 (20%)	8 (9.3%)	
$20,000 - $29,999	11 (12.9%)	5 (5.8%)	
$30,000 - $39,999	7 (8.2%)	6 (7%)	
$40,000 - $49,999	2 (2.4%)	14 (16.3%)	
$50,000 - $59,999	1 (1.2%)	8 (9.3%)	
$60,000 - $69,999	3 (3.5%)	7 (8.1%)	
$70,000 - $79,999	2 (2.4%)	8 (9.3%)	
$80,000 - $89,999	2 (2.4%)	2 (2.3%)	
$90,000 - $99,999	1 (1.2%)	2 (2.3%)	
$100,000 or more	4 (4.7%)	5 (5.8%)	
Declined to answer	0	2 (2.3%)	
Unknown	1 (1.2%)	0	
Current employment, n (%)			
Unemployed, not looking	11 (12.9%)	7 (8.1%)	
Unemployed, looking	5 (5.9%)	9 (10.5%)	
Part-time competitive employment	17 (20%)	13 (15.1%)	
Full time competitive employment	18 (21.2%)	49 (57%)	
Part time special employment	0	1 (1.2%)	
Full time special employment	3 (3.5%)	0	
Retired	6 (7.1%)	7 (8.1%)	
Other	25 (29.4%)	0	

Table 2: Patient characteristics of TBI group –AIHQ:

Variables	**TBI group N = 85**
Time since injury [Mean (SD)] years	8.5 (9.4)
Age at the time of injury [Median (min, max)]	28.0 (12.0,70.0)
Type of injury, n (%)	
Closed	79 (92.9%)
Penetrating	5 (5.9%)
Crush	1 (1.2%)

Cause of injury, n (%)	
Vehicular	36 (42.4%)
Fall	17 (20.0%)
Assault	8 (9.4%)
Other	24 (28.2%)
Post-traumatic amnesia, n (%)	
<1 hr	6 (7.4%)
>1 hr, but <24 hrs	4 (5.0%)
1-6 days	11 (13.6%)
7-13 days	10 (12.4%)
14-20 days	6 (7.4%)
21-29 days	12 (14.8%)
30-59 days	18 (22.2%)
>60 days	14 (17.3%)
Missing	4
Loss of consciousness, n (%)	
<30 mins	25 (32.9%)
>30 mins, but <24 hrs	16 (21.1%)
1-6 days	13 (17.1%)
7-13 days	6 (7.9%)
14-20 days	5 (6.6%)
21-29 days	2 (2.6%)
30-59 days	8 (10.5%)
>60 days	1 (1.3%)
Missing	9

Table 3: Correlations of AIHQ Intent, Hostility, and Blame scales with AIHQ anger and aggression scales for TBI group (n=85). AIHQ anger and AIHQ aggression scores used for correlations were averages from the scenario type that was specified under the atttributions (all, ambiguous, intentional, or accidental). r_s=Spearman correlations. P-Val=adjusted p-value.

	AIHQ anger	**AIHQ aggression**
	r_s(P-Val)	**r_s(P-Val)**
Attributions of Intent		
All scenarios	0.50 (<0.001)	0.47 (<0.001)
Ambiguous scenarios	0.57 (<0.001)	0.36 (0.002)

Intentional scenarios	0.32 (0.003)	0.16 (0.144)
Accidental scenarios	0.55 (<0.001)	0.44 (<0.001)
Attributions of hostility		
All scenarios	0.39 (0.027)	0.45 (<0.001)
Ambiguous scenarios	0.49 (<0.001)	0.30 (0.005)
Intentional scenarios	0.18 (0.100)	0.36 (0.003)
Accidental scenarios	0.28 (0.040)	0.33 (0.004)
Attributions of blame		
All scenarios	0.65 (<0.001)	0.43 (<0.001)
Ambiguous scenarios	0.71 (<0.001)	0.36 (0.003)
Intentional scenarios	0.57 (<0.001)	0.27 (0.012)
Accidental scenarios	0.66 (<0.001)	0.40 (0.004)

Table 4: Testing for the difference in the means of two groups for AIHQ variables. All scales ranged from 1-5, except attributions of intent. SD: standard deviation. CI: Confidence Interval

Variable	**TBI group (N = 85)** Mean (SD)	**HC group (N = 86)** Mean (SD)	**Hochberg adjusted P-value**	**Cohen's effect size (CI)**
Attributions of intent				
All scenarios	3.47 (0.7)	3.15 (0.5)	0.001	0.53 (0.22, 0.83)
Ambiguous scenarios	3.21 (1.1)	2.63 (0.9)	0.001	0.58 (0.27, 0.88)
Intentional scenarios	5.30 (0.7)	5.20 (0.7)	0.345	0.14 (-0.16, 0.44)
Accidental scenarios	1.89 (0.9)	1.62 (0.6)	0.036	0.35 (0.05, 0.65)
Attributions of hostility				
All scenarios	1.78 (0.3)	1.61 (0.2)	<0.001	0.67 (0.36, 0.97)

Ambiguous scenarios	1.86 (0.5)	1.56 (0.4)	<0.001	0.66 (0.35, 0.97)
Intentional scenarios	2.21 (0.4)	2.14 (0.4)	0.212	0.18 (-0.13, 0.47)
Accidental scenarios	1.26 (0.4)	1.12 (0.2)	0.001	0.44 (0.14, 0.74)
Attribution of blame				
All scenarios	1.78 (0.3)	1.61 (0.2)	<0.001	0.61 (0.30, 0.92)
Ambiguous scenarios	3.07 (1.0)	2.49 (0.7)	<0.001	0.67 (0.36, 0.98)
Intentional scenarios	4.33 (0.8)	4.16 (0.7)	0.133	0.23 (-0.08, 0.53)
Accidental scenarios	2.36 (1.0)	1.98 (0.8)	0.012	0.42 (0.11, 0.72)
AIHQ Anger response				
All scenarios	2.67 (0.7)	2.40 (0.5)	0.021	0.44 (0.14, 0.75)
Ambiguous scenarios	2.43 (0.8)	2.08 (0.7)	0.010	0.47 (0.16, 0.77)
Intentional scenarios	3.50 (0.9)	3.26 (0.7)	0.087	0.30 (0.00, 0.60)
Accidental scenarios	2.04 (0.8)	1.85 (0.6)	0.087	0.27 (-0.03, 0.57)
AIHQ Aggression response				
All scenarios	2.01 (0.4)	1.81 (0.3)	0.002	0.57 (0.26, 0.87)
Ambiguous scenarios	1.88 (0.4)	1.71 (0.2)	0.002	0.54 (0.23, 0.84)
Intentional scenarios	2.35 (0.6)	2.11 (0.5)	0.015	0.44 (0.13, 0.74)
Accidental scenarios	1.79 (0.6)	1.58 (0.5)	0.015	0.38 (0.08, 0.68)

Table 5: Correlation of Ambiguous-only scenarios versus average scores for all AIHQ scenarios in TBI group (n=85)

		Ambiguous-only scenarios
		r_s(P-Val)
Intent		0.93 (<0.001)
Hostility		0.81 (<0.001)
Blame	**Total**	0.89 (<0.001)
Anger		0.87 (<0.001)
Aggression		0.74 (<0.001)