

## Cognitive and psychosocial correlates of alexithymia following traumatic brain injury<sup>☆</sup>

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### Abstract

Changes in emotional and social behaviour are considered to be amongst the most common and debilitating consequences of traumatic brain injury (TBI). Little is known of the effects of TBI on alexithymia, which refers to impairment in aspects of understanding emotions. In the current study TBI patients ( $N=28$ ) were compared with demographically matched healthy controls ( $N=31$ ) on the Toronto Alexithymia Scale-20 (TAS-20), a measure that taps three distinct characteristics of the alexithymia concept; difficulty in identifying emotions, difficulty in describing emotions and externally oriented thinking. Patients and controls also completed measures of anxiety, depression, quality of life, and measures of fluency to assess executive function. Patients showed greater levels of alexithymia, in terms of difficulty identifying emotions and reduced introspection. Difficulty in identifying emotions was associated with poorer quality of life, even when depression and anxiety were controlled. Difficulty in identifying emotions was also uniquely associated with executive function deficits. Thus, although studies typically focus on aspects of cognitive change following head injury, these results lend support to Becerra et al.'s (Becerra, R., Amos, A., & Jongenelis, S. (2002). Organic alexithymia: a study of acquired emotional blindness. *Brain Injury*, 16, 633–645.) notion of an 'organic alexithymia', and suggest that more attention should be focused upon assessment of emotional change post-head injury.

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### 1. Introduction

Although precise definitions vary, there is a general consensus in the literature that alexithymia is characterised by a reduction in the tendency to think about emotions, and to engage in fantasising, as well as a deficit in the ability to consciously experience, describe and identify emotions (Larsen, Brand, Bermond, & Hijman, 2003; Taylor, Bagby, & Parker, 2003). Increasingly attention has been focused on the assessment of alexithymia, as it is associated with increased depres-

sion (Hintikka, Honkalampi, Lehtonen, & Viinamaki, 2001), anxiety (Eizaguirre, de Cabezon, de Alda, Olariaga, & Juaniz, 2004), hostility (Waldstein, Kauhanen, Neumann, & Katzel, 2002), as well as reduced life satisfaction (Scmitz, 2000), and low positive affect (Lundh & Simonsson-Sarnecki, 2001). Moreover, a relationship with somatic illness and disease is reliably reported (Taylor, 2000).

Traumatic brain injury (TBI) is the most common cause of brain damage and is usually typified by focal damage superimposed on more diffuse white-matter and brain-stem damage. Changes in emotional and social behaviour are considered to be amongst the most common and debilitating consequences of TBI. Many patients fail to return to work or maintain meaningful social relationships as a result of these changes, and for relatives these emotional changes are

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often a greater burden than the physical impairments (Malia, Powell, & Torode, 1995). Both clinically and anecdotally, it is the control or regulation of emotions that is reported to be impaired in TBI, and is thus presumed to underlie these changes in emotional and social behaviour.

It is therefore of interest that Parker, Taylor, and Bagby (2003) argue that the core disturbance in alexithymia is a deficit in the cognitive processing and *regulation* of emotions. Thus, some of the emotional and behavioural disturbances associated with head injury may reflect the presence of 'organic' alexithymia. Becerra, Amos, and Jongenelis (2002) introduced this phrase to further understanding of alexithymic symptoms associated with acquired brain injury, and reported data on a single case study, in which post-head injury the patient presented with a syndrome substantially similar to alexithymia. Other evidence consistent with the possibility of a link between head injury and alexithymia was presented by Williams et al. (2001). The Traumatic Brain Injury Questionnaire and the Toronto Alexithymia Scale (TAS) were administered to 135 patients attending a family practice residency facility. It was found that 49% of individuals reported a history of head injury, and of these a significantly higher proportion of individuals were alexithymic compared with individuals not reporting a history of head injury. Moreover, Allerdings and Alfano (2001) found that patients with moderate to severe TBI ( $N = 11$ ) presented with significantly higher levels of alexithymia as indexed by the TAS relative to healthy controls ( $N = 13$ ).

Neuropathologically there is also evidence that TBI may be particularly associated with alexithymic behaviour. Alexithymia has been linked to abnormalities in the prefrontal cortex (Berthoz et al., 2002; Gundel et al., 2004; Kano, Fukudo, & Gyoba, 2003), and patients with frontal damage often exhibit alexithymic behaviour (see Larsen et al., 2003). Focal contusions are most frequently found in frontal regions following traumatic brain injury (Levin & Kraus, 1994; Levin, Williams, Eisenberg, High, & Guinto, 1992) and it has been demonstrated that in terms of cognitive performance, patients with TBI present with a profile of deficits that is analogous to focal frontal patients. For instance, cognitive control functions are disproportionately affected by both types of injury, as indexed by tests of phonemic and semantic fluency (Crawford & Henry, 2005; Henry & Crawford, 2004a,b). Thus, it may be that the presence of frontal abnormalities in TBI also impact upon the control functions implicated in regulation of affect; as noted earlier, emotional dysregulation is considered by some to underlie the characteristics of alexithymia (Taylor, Bagby, & Parker, 1997).

Since the executive functions operative in emotional regulation are also thought to be particularly dependent upon the integrity of the frontal lobes (Stuss & Levine, 2002) it may be that there are neuropsychological contributions to alexithymia in TBI. Assessment of this issue is important as it bears on whether similar brain areas are recruited by emotional and cognitive control processes, which has been identified as a key aim of the emerging field of 'social cogni-

tive neuroscience' (Ochsner & Lieberman, 2001). However, the relationship between alexithymia and neuropsychological test performance has not previously been assessed in the context of TBI. One aim of the current research is therefore to investigate whether TBI effects on alexithymia are related to, or independent of concurrent effects on executive functioning. This has important implications for the assessment and treatment of emotional dysfunction in TBI.

Executive functioning is thought to be responsible, not for basic cognitive processes, but for the set of behavioural competencies that integrate these capacities (Stuss & Benson, 1986). This aspect of cognition is therefore multifactorial, and a range of abilities are normally understood to belong to this construct (see; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Cognitive tasks particularly dependent on executive processes include those presumed to impose substantial demands on self-directed planning and strategy formation (Stuss & Benson, 1986), future-oriented, goal-directed, non-habitual behaviour (Perret, 1974; Phillips, 1997; Welsh, Satterlee-Cartmell, & Stine, 1999), self-initiated retrieval (Henry, McLeod, Phillips, & Crawford, 2004) and cognitive set-shifting (Miyake et al., 2000). The current study will focus on a widely used measure of executive function, verbal fluency, which depends heavily on self-initiated retrieval and strategy formation, as well as a variant of the task (alternating fluency) that imposes additional demands upon cognitive set-shifting.

Standard measures of phonemic and semantic fluency were selected as these are amongst the best validated measures of executive functioning (see Crawford & Henry, 2005; Henry & Crawford, 2004a), and in a recent meta-analytic review were shown to be very sensitive to the presence of TBI (Henry & Crawford, 2004b). To increase the executive load in the fluency tasks alternating fluency measures will also be used. Alternating fluency tasks are like standard fluency tasks in that the participants must generate as many words as they can either beginning with a letter (phonemic), or belonging to a category (semantic). However, an additional requirement is that participants must alternate between fluency probes when generating words. Thus, for alternating fluency using the probes 'R' and 'clothing', the participant would be asked to alternate between generating words beginning with 'R' and items of clothing. As noted, the capacity for mental flexibility or switching is widely regarded as core to mainstream conceptualizations of executive functioning (Stuss & Benson, 1986). It is therefore surprising that to the present authors' knowledge no study to date has investigated the degree to which alternating fluency is affected by the presence of TBI.

In the present study, performance on standard and alternating fluency measures will therefore be quantified, and their relationship to alexithymia assessed. Moreover, the possibility that different components of the alexithymia construct may be differentially related to executive dysfunction will be investigated. In both clinical and non-clinical research the Toronto Alexithymia Scale (TAS; Bagby, Taylor, & Parker,

1994) is by far the most extensively used measure of alexithymia. Factor analyses typically indicate that the most recent 20-item version (TAS-20) taps three distinct factors that correspond to the following sub-scales: ‘Difficulty Identifying Emotions’ (DIE), ‘Difficulty Describing Emotions’ (DDE), and ‘Externally-Oriented Thinking’ (EOT). Whereas DIE refers to problems identifying and distinguishing between emotions and bodily sensations (e.g., item 7 on the TAS-20: “I sometimes find it difficult to explain sensations in my body”), DDE refers to a deficit or inability to verbally express emotions (e.g., item 2 on the TAS-20: “It is difficult to find the right words for my feelings”). EOT refers to a concrete, reality based, and non-introspective cognitive style (e.g., item 15 on the TAS-20: “I prefer talking to people about their daily activities rather than their feelings”).

Spalletta et al. (2001) found that DIE and DDE, (but not EOT) differentiated right hemisphere from left hemisphere stroke patients. Further, Henry, Phillips, Maylor, Hosie, and Milne (2005) found that in a sample of 248 healthy adults, whereas higher scores on the DIE and DDE sub-scales were associated with increased anxiety, depression and negative affect, higher scores on the EOT sub-scale were associated with reduced anxiety and negative affect, and thus could not be construed as a ‘deficit’. Henry et al. (2005) suggested that in healthy adults the EOT sub-scale therefore does not measure an emotion regulation deficit, but instead a style of avoiding introspective thought.

It remains unclear whether the three TAS-20 sub-scales measure overlapping skills in a TBI population. Becerra et al. (2002) found that post-head injury, patient HR reported higher scores on the DIE and DDE sub-scales, but not the EOT sub-scale, relative to self-reported estimates of pre-morbid symptoms. Indeed, for the EOT sub-scale, scores actually decreased following head injury. However, generalisations on the basis of results from a single case study are clearly limited, and since this is the only study to date that has reported sub-scale scores for the TAS-20 in head injured patients, there is a clear need for further research. Although Williams et al. (2001) and Allerdings and Alfano (2001) found that there was a relationship between alexithymia and traumatic brain injury, only total scores for the TAS-20 were presented in each of these studies. It is therefore not clear whether the increases in alexithymia reported in these studies were attributable to a generalised increase, or as found in Becerra et al. (2002) single case study, a specific increase in particular characteristics of alexithymia.

Moreover, no study to date has assessed whether, if patients with head injury score more highly on measures of alexithymia, this is simply attributable to elevated levels of depression and anxiety. Both anxiety and depression are often associated with TBI (Holsinger et al., 2002; Williams, 2003) and both are strongly related to alexithymia in other clinical and non-clinical groups (Eizaguirre et al., 2004; Hintikka et al., 2001; Marchesi, Brusamonti, & Maggini, 2000). Eizaguirre et al. (2004), for instance, found that although patients with eating disorders reported higher levels

of alexithymia than controls on the TAS-20, these differences disappeared after partialling out anxiety and depression. Marchesi et al. (2000) also found that the HADS anxiety items and items from the DIE scale loaded on one factor in a combined factor analysis, suggesting some overlap between alexithymia and anxiety as measured by these scales. Thus, if any differences between patients and controls emerge in the present study, it is important to address whether these may be explained by group differences in depression and anxiety.

Finally, in a recent review article, Dijkers (2004) concluded that TBI is reliably associated with reduced quality of life (QOL) as indexed via a variety of methodologies such as self-report and objective behavioural indices. However, many of the factors that predict QOL post TBI remain to be clarified. Corrigan, Bogner, Mysiw, Clichot and Fugate (2001), for instance, conducted a prospective longitudinal study to investigate the correlates of life satisfaction after TBI using the Satisfaction with Life Scale. Two years post-injury, current social integration and depression were significant predictors of life satisfaction, and it was recommended that: “Future research should investigate other factors that affect life satisfaction.” (p. 543). To date, no study has investigated the potential relationship between alexithymia and life satisfaction following TBI. However, to do so is important, particularly given that alexithymia has been specifically linked to increased depression (Lipsanen, Saarijarvi, & Lauerma, 2004) as well as reduced social integration (Lumley, Oviess, Stettner, Wehmer, & Lakey, 1996).

### 1.1. Research issues to be addressed in the current paper

In the present study it will be assessed (1) whether there are any differences in levels of alexithymia between TBI patients and healthy controls on different dimensions of the TAS-20, and whether any observed differences remain after controlling for depression and anxiety. A second aim (2) is to assess whether alexithymia is related to deficits in executive functioning, as indexed by tests of fluency. Again, it will be assessed whether any observed relationships remain after controlling for depression and anxiety. In order to investigate the potential effects of alexithymia on mood and life satisfaction, the third aim (3) is to quantify the relationship between alexithymia with depression, anxiety and QOL, and (4) investigate whether differences in self-reported alexithymia predicts *unique* variance in QOL after controlling for depression and anxiety.

## 2. Method

### 2.1. Participants

Twenty-eight adults (22 males, 6 females) between the ages of 18 and 67 ( $M=40.3$ ,  $S.D.=13.6$ ) who had sustained a TBI were recruited from the outpatient records of

the Department of Neurosurgery, Aberdeen Royal Infirmary. The mean length of posttraumatic amnesia was 13 days (S.D. = 14). None of the patients reported a history of psychiatric disease or a premorbid history of alcohol or drug addiction. Cause of injury included motor vehicle accidents (50%), falls (21%), and assaults (11%), whilst the remaining 18% were attributable to other causes, such as being involved in a domestic accident or an explosion. Thirty-one healthy participants (24 males, 7 females) served as controls. The majority (over 80%) of control participants were friends, relatives or caregivers of the TBI patients. The remainder were recruited via advertisements in community newsletters, approaching various organisations (e.g., bowling clubs, rural women's institute, local charitable organisations), or from the Public Participation Panel at the University of Aberdeen. In addition to being matched to TBI patients for gender, controls were carefully matched for age ( $M = 39.8$ , S.D. = 17.68) and education ( $M = 13.3$ , S.D. = 3.40). All participants received remuneration to cover travel expenses. Ethical approval to conduct this study was provided by the Grampian Research Ethics Committee, and all participants gave informed consent prior to their inclusion in the study.

Clinical notes referring to the results of MRI or CT scans were available for 18 patients. These indicated varied pathologies, including skull fractures, contusions, intracerebral or subarachnoid hemorrhages and subdural and extradural hemorrhages. Whilst the majority of patients presented with bilateral injuries (10), some had specifically right or left focused injuries (3 and 5, respectively). Nine of the 18 patients were reported to have lesions that specifically implicated the frontal lobes: this is consistent with other research indicating the particular vulnerability of frontal cortical structures in TBI.

## 2.2. Measures

### 2.2.1. Toronto alexithymia scale

The 20-item Toronto Alexithymia Scale (TAS-20) represents by far the most widely used measure of this construct, and has been translated into 18 different languages (Taylor et al., 2003). Each item is rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores on each of these sub-scales are indicative of increased alexithymia. In the present study, Chronbach's alpha reliability coefficients for the Total, DIE, DDE and EOT sub-scales are .86, .91, .68 and .53, respectively. With respect to this latter value: the internal consistency of the EOT sub-scale has consistently been found to be unsatisfactorily low (see; Kooiman, Spinhoven, & Trijsburg, 2002).

### 2.2.2. Verbal fluency tests

To tap executive functioning, each participant completed a test of phonemic fluency (using the probes: F, A and S), three semantic fluency tasks (using the probes: animals, fruits and vegetables), and an alternating fluency task (using the probes: R-things to wear). The variants selected for the stan-

dard phonemic and semantic fluency trials were chosen because these are the probes most often used in clinical practice and research. For the alternating fluency measure, words and letters were selected on the basis that it was possible to generate a large number of exemplars for each of the probes. The degree to which the standard and alternating fluency measures were equated for difficulty was not specifically assessed as the interest was in the influence of TBI, not the absolute number of words generated across conditions.

For each fluency probe, participants were given one minute to produce as many exemplars as possible. Cue cards were held up by the experimenter to remind participants of the relevant probe; for the alternating condition the relevant two cards were alternated by the experimenter to cue the participant prior to each response. Participants' responses were recorded on an audio-cassette recorder. For each fluency condition, the dependent measure was the total number of responses, minus repetitions and inappropriate responses.

### 2.2.3. Hospital anxiety and depression scales (HADS; Zigmond & Snaith, 1983)

The HADS was developed to provide a brief means of identifying and measuring severity of depression and anxiety in non-psychiatric clinical environments. It consists of 14 items, 7 of which measure depression, the other seven anxiety. The respondent is asked to underline the reply that most closely matches how they have felt during the past week. In the present sample, Chronbach's alpha for the total, anxiety and depression scales is .91, .90 and .86, respectively.

### 2.2.4. LEIPAD

The LEIPAD is a 27-item self-report questionnaire developed by de Leo et al. (1998) which provides an overall index of QOL. The measure has been validated cross-culturally, and found to be psychometrically sound (de Leo et al., 1998). Chronbach's alpha for the Total scale is .94.

## 3. Results

### 3.1. Levels of alexithymia in traumatic brain injured patients

Table 1 summarises  $M$  and S.D.s on the TAS-20, HADS and LEIPAD for TBI patients and controls. It is strongly recommended that effect sizes be presented in primary research articles (see American Psychological Association guidelines). Effect sizes of group differences expressed as Cohen's  $d$  are therefore also given in Table 1; Cohen (1988) defines effect sizes of .2 as small, .5 as medium, and .8 as large. In terms of effect size, TBI patients consider themselves to be more alexithymic on all dimensions of the TAS-20, with effects ranging in magnitude from .29 for the DDE sub-scale to .64 for the Total scale. The clinical cut-off recommended by Taylor et al. (1997) on the TAS-20 is  $\geq 61$ ; whilst 12.9% of controls would be considered 'alexithymic' if this cut-off

Table 1  
TAS-20, HADS and Quality of Life scores for TBI patients vs. healthy controls

	TBI ( <i>N</i> = 28)		Control ( <i>N</i> = 31)		<i>d</i>	ANOVA	
	<i>M</i>	S.D.	<i>M</i>	S.D.		<i>F</i> (1, 57)	<i>p</i>
TAS-20							
Total	55.9	10.47	49.4	10.19	.64	5.84	.019
Difficulty identifying emotions	18.3	6.57	14.8	5.44	.58	4.86	.032
Difficulty describing emotions	14.4	3.07	13.4	3.86	.29	1.22	.275
Externally oriented thinking	23.1	3.69	21.1	3.74	.56	4.45	.039
HADS							
Depression	6.5	4.45	3.4	3.73	.76	8.34	.005
Anxiety	7.9	4.86	7.4	4.01	.12	0.22	.641
LEIPAD Quality of Life	43.1	14.07	50.5	8.95	-.65	6.05	.017

A positive value of *d* indicates that TBI patients are scoring more highly on the dimension in question; a negative value indicates the reverse.

were to be applied, almost a third (32.1%) of TBI patients scored  $\geq 61$ . Although TBI patients consider themselves to be substantially more depressed than controls ( $d = .76$ ) levels of anxiety differ only slightly between the two groups ( $d = .12$ ). TBI is associated with a substantially reduced QOL ( $d = -.65$ ).

To investigate whether any of the observed differences between patients and controls are significant, a series of Analyses of Variances (ANOVAs) were carried out. These results are also presented in Table 1. Whilst TBI patients are significantly more alexithymic in terms of Total TAS score, DIE and EOT, DDE did not differentiate the groups. TBI patients are significantly more depressed, though not more anxious, and consider themselves to have a significantly worse quality of life relative to controls.

In order to assess whether any differences in alexithymia between TBI patients and controls are attributable to increased anxiety or depression, a series of Analyses of Covariances (ANCOVAs) were calculated in which Anxiety and Depression scores were entered as control variables. The ANOVAs which revealed significant effects were associated with effect sizes of .64, .58 and .56 for the Total, DIE and EOT sub-scales, respectively. After ANCOVA (controlling for both depression and anxiety), these *d* values were attenuated; *d* values of .51, .50 and .50, respectively, were observed, and each of these effects just failed to attain significance ( $p = .061$ ,  $.070$  and  $.068$ , respectively). These results indicate that at least some of the variance in TAS-20 scores can be explained by variance shared with anxiety and depression. However, it is increasingly recognised that effect sizes may be more informative than simply reporting whether a

particular effect is significant or not (see American Psychological Association guidelines). It is therefore important to emphasize that each of these effects remained of a moderate magnitude according to Cohen (1988) criteria.

### 3.2. Standard and alternating fluency performance

Performance on the fluency measures is reported in Table 2; it can be seen that patients are substantially impaired on all the fluency measures; all effects are moderate or large in magnitude according to Cohen (1988) criteria. Further, all effects are significant, with the exception of phonemic fluency which just falls short ( $p = .060$ ). Alternating fluency is more sensitive to TBI than either phonemic or semantic fluency as indexed by its larger absolute effect size.

### 3.3. Alexithymia and fluency

With respect to the relationship between alexithymia and fluency; it can be seen in Table 2 that scores on the DIE and EOT dimensions are essentially unrelated to fluency performance. However, there are moderate correlations between the DIE dimension and each of the fluency measures (*r* ranges from  $-.25$  to  $-.30$ ). The correlation between DIE with semantic fluency, and alternating fluency both attain significance. Higher scores on the DIE dimension (indicative of increased alexithymia), is therefore associated with poorer fluency performance. Although not reported in Table 2, these correlations were also calculated separately for patients and controls: the same basic pattern of correlations was observed for both groups.

Table 2  
Executive measures for TBI patients versus healthy controls and correlations with TAS-20 measures

	TBI ( <i>N</i> = 28)		Control ( <i>N</i> = 31)		<i>d</i>	<i>t</i> -tests		Correlations			
	<i>M</i>	S.D.	<i>M</i>	S.D.		<i>t</i> (1, 57)	<i>p</i>	Total	DIE	DDE	EOT
Phonemic	36.3	12.87	41.9	9.58	.51	1.92	.060	-.17	-.25	-.10	.02
Semantic	37.6	10.88	44.9	9.75	.72	2.72	.009	-.25	-.30*	-.14	-.09
Alternating	14.4	3.65	17.8	3.74	.92	3.47	.001	-.18	-.27*	-.06	-.02

\*  $p < .05$ .

As noted previously, depression and anxiety are often highly correlated with alexithymia, and both are also associated with poor performance on cognitive measures such as fluency (see; Henry & Crawford, 2005). In the present study although correlations between fluency and anxiety were of a small magnitude ( $r$  ranged from  $-.04$  to  $-.12$ ), the correlations between depression and each of the fluency measures were of a comparable magnitude to the correlations between DIE and the fluency measures ( $r$  ranged from  $-.24$  to  $-.31$ ).

Partial correlations were therefore calculated to address the possibility that the correlations observed between each of the fluency measures with the DIE dimension are attributable to shared variance with depression and anxiety. Controlling for these variables does not alter the magnitude of the relationship between semantic fluency and DIE ( $r = -.30$ ), and thus this effect remains significant. Whilst the specific relationship between alternating fluency and DIE is no longer significant, it remains virtually unchanged in absolute magnitude ( $r = -.27$ ; partial  $r = -.25$ ), and only just fails to attain significance ( $p = .06$ ).

### 3.4. Alexithymia and well-being

In Table 3, the global correlation matrix between the alexithymia sub-scales, and indicators of mood (HADS anxiety and depression scores) and QOL (LEIPAD) are reported, collapsed across patients and controls, and separately for each sub-group. With respect to the specific relationships between alexithymia and psychosocial functioning, it can be seen that across the total, TBI and control groups, whilst EOT is unrelated to depression, anxiety and QOL, higher levels of alexithymia as indexed by the total, DIE and DDE sub-scales are associated with increased depression, increased anxiety, and a reduced QOL.

Finally, four hierarchical regression analyses, collapsed across patients and controls, were performed to examine the extent to which QOL variance could be explained by total, DIE, DDE and EOT scores. In order to examine the ability of the measures to explain variance that is independent of depression and anxiety, shared variance was partialled out by entering HADS depression and anxiety scores as the first and second predictors, respectively, in each of the regression models. This was then followed by entry of Total (Model 1), DIE (Model 2), DDE (Model 3), or EOT (Model 4) TAS-20 scores. The results are presented in Table 4, and indicate that only DIE is a significant predictor of QOL variance, independent of depression and anxiety. Thus, DIE accounts for 2.6% of the residual variance in QOL scores. The Total, DDE and EOT sub-scales accounted for 1.2, .9 and 0%, respectively. These analyses were also conducted for the patient and control groups separately. Whilst DIE did not explain significant unique variance after controlling for Depression and Anxiety as a consequence of low statistical power, the absolute magnitude of unique variance explained was slightly higher in the TBI relative to the control group (2.4 versus 1.8%, respectively).

Table 4  
Hierarchical multiple regressions

Criterion: QOL	Predictor	$r$	$r^2$ change	$p$	
Model 1					
	Step 1	HADS depression	.766	.587	<.001
	Step 2	HADS anxiety	.822	.088	.002
	Step 3	Total TAS-20	.829	.012	.153
Model 2					
	Step 1	HADS depression	.766	.587	<.001
	Step 2	HADS anxiety	.822	.088	.002
	Step 3	TAS-20 DIE	.837	.026	.032
Model 3					
	Step 1	HADS depression	.766	.587	<.001
	Step 2	HADS anxiety	.822	.088	.002
	Step 3	TAS-20 DDE	.827	.009	.222
Model 4					
	Step 1	HADS depression	.766	.587	<.001
	Step 2	HADS anxiety	.822	.088	.002
	Step 3	TAS-20 EOT	.822	<.001	.756

Extent to which variance in quality of life (QOL) scores can be explained by scores on the TAS-20 ( $N = 59$ ).

## 4. Discussion

### 4.1. Alexithymia and closed head injury

TBI patients were impaired in the capacity to identify their own negative and positive emotional responses as indexed by the DIE scale. Lane, Sechrest, Riedel, Shapiro and Kaszniak (2000) suggest that deficits in the recognition of emotions in exteroceptive stimuli may be considered an indirect index of the recognition of interoceptive stimuli. It is therefore of interest that TBI is also associated with a decreased capacity to recognise emotions in others: both in terms of facial expressions and tone of voice (Hopkins, Dywan, & Segalowitz, 2002; Jackson & Moffat, 1987; McDonald & Pearce, 1996; Milders, Fuchs, & Crawford, 2003). McDonald and Flanagan (2004) for instance, found that TBI patients were significantly impaired in the ability to recognise the emotional and mental state of others when asked to interpret videotaped conversational exchanges. The present results are therefore consistent with other evidence that TBI is characterised by deficits in identifying emotions, but indicate that this generalises to patients' own emotions, and is not simply restricted to recognition of other peoples' feelings. Whilst further research is needed to precisely clarify the nature of the underlying impairment in TBI, it is of interest that Lane et al. (2000) suggest that emotion recognition deficits do not simply reflect a deficit in the capacity to symbolize emotion, but a more general deficit in the capacity for emotion information processing.

Higher scores on the DIE and DDE sub-scales were strongly associated with negative mood and QOL outcomes. This is entirely consistent with other studies that have found both DIE and DDE to be negatively associated with important markers of mental well-being (Gunzelmann, Kupfer, &

Table 3  
Correlations between alexithymia, depression, anxiety and quality of life

	Total TAS-20	TAS-20 DIE	TAS-20 DDE	TAS-20 EOT	Depression	Anxiety
Total group						
Total TAS-20 ( <i>N</i> = 59)	–					
TAS-20 DIE	.89**	–				
TAS-20 DDE	.84**	.70**	–			
TAS-20 EOT	.59**	.23	.31*	–		
HADS depression	.44**	.45**	.45**	.09	–	
HADS anxiety	.48**	.55**	.52**	–.04	.59**	–
Quality of life	–.51**	–.58**	–.52**	–.01	–.77**	–.67**
TBI group ( <i>N</i> = 28)						
Total TAS-20	–					
TAS-20 DIE	.91**	–				
TAS-20 DDE	.84**	.76**	–			
TAS-20 EOT	.51**	.17	.20	–		
HADS depression	.32	.43*	.42*	–.20	–	
HADS anxiety	.47*	.58**	.43*	–.05	.62**	–
Quality of life	–.49**	–.62**	–.50**	.12	–.78**	–.79**
Control group ( <i>N</i> = 31)						
Total TAS-20	–					
TAS-20 DIE	.85**	–				
TAS-20 DDE	.86**	.66**	–			
TAS-20 EOT	.60**	.18	.35	–		
HADS depression	.42*	.33	.46**	.18	–	
HADS anxiety	.50**	.53**	.62**	–.06	.52**	–
Quality of life	–.44*	–.43*	–.58**	–.02	–.68**	–.53**

\*  $p < .05$ .

\*\*  $p < .01$ .

Brähler, 2002; Henry et al., 2005; Waldstein et al., 2002), but is the first to document this relationship in the context of TBI. This suggests that assessing and treating the emotional processing deficits associated with TBI should be seen as an urgent priority, given that emotional deficits such as alexithymia are substantially correlated with mood disorder and self-rated QOL.

Moreover, when regression analyses were conducted to examine whether any variance in QOL was explained by different sub-scales of the TAS-20, DIE was a significant predictor. Whilst not large in absolute magnitude, we consider 2.6% of the residual variance in QOL scores to be of clinical significance, particularly given that this is *unique* variance, not attributable to either depression or anxiety. Nevertheless, it is clearly important to cross-validate these results in independent samples, and in particular, to do so using alternative measures of alexithymia (this point will be returned to again later). As noted, the reliabilities of the TAS-20 sub-scales differed, and it is possible that this may have influenced the results of the regression analyses. Moreover, the reliability of the results of the hierarchical regression analyses is restricted by the relatively small number of cases, the fact that the predictors were correlated, and because the analyses involved pooling data from two extreme groups. However, with respect to this latter point it should be reiterated that these analyses were also conducted for the patient and control groups separately and yielded analogous results for each.

The results from the present study also clearly indicated that TBI patients are less introspective, as they engage in more externally oriented thinking relative to matched controls. However, it is more problematic to interpret what higher scores on the EOT sub-scale represent in TBI. Although higher scores on this dimension are usually considered to constitute an emotional deficit, EOT was essentially unrelated to self-reported depression, anxiety and well-being in the total sample, as well as in the TBI and control groups specifically. This indicates that EOT is not related to self-reports of lowered mood or life satisfaction.

It might be argued that the EOT sub-scale is picking up on aspects of emotional or cognitive functioning which tap into a different aspect of alexithymia than is measured by the other two sub-scales. It could potentially be seen as problematic for the DIE and DDE sub-scales that both show correlations with other self-report mood measures as individuals who score highly on measures of negative affectivity may also score highly on the DIE and DDE sub-scales because they have a general tendency towards self-criticism or a self-effacing response style. The EOT sub-scale is unrelated to mood measures, and so may be tapping into a more unique emotional deficit. Additionally, the EOT sub-scale does not require participants to make judgements about their own deficits with regard to the experience and expression of emotions, and so self-reporting for the EOT sub-scale may be more accurate than for the other scales. Waller & Scheidt (2004) also found that the EOT sub-scale exhibits better

convergent validity with objective measures of alexithymia, such as the Levels of Emotional Awareness Scale (LEAS; Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990) and the Affect Consciousness Interview (Monsen, Eilerstein, Melgard, & Odegard, 1996).

However, it has also been suggested that avoiding introspection may not constitute a salient feature of the alexithymia construct (Loas et al., 2001). Further, the EOT sub-scale of the TAS-20 has been subjected to a great deal of criticism. It has been argued that heightened scores on this measure should not be construed as indicative of a deficit in non-clinical samples because scores are unrelated or *positively* related to other markers of emotional well-being (Henry et al., 2005). Moreover, the reliability and validity of the EOT sub-scale has consistently been questioned. The EOT sub-scale demonstrates lower internal consistency relative to the other sub-scales of the TAS-20 (see; Henry et al., 2005; Kooiman et al., 2002), a finding that was replicated in the present study. Muller, Buhner and Ellgring (2003) also argue that the conceptual clarity of the EOT sub-scale needs to be improved, whereas Becerra et al. (2002) suggest that patients with TBI may experience difficulty understanding the wording of questions on the EOT sub-scale. Thus, it is clearly problematic to interpret what higher scores on the EOT sub-scale represent in TBI.

However, the present results do suggest that the characteristics of individuals with TBI differ qualitatively as well as quantitatively from healthy adults. Whilst both DIE and DDE appear to tap a 'deficit' in emotional processing in TBI (in that they are associated with reduced mood and well-being), only the former differentiates patients and controls. Thus, there was a trend towards TBI patients considering themselves to experience greater difficulty describing emotions (DDE;  $d = .29$ ), but this was substantially smaller than the corresponding perceived deficit for identifying emotions (DIE;  $d = .58$ ). Thus, these results suggest that TBI is particularly associated with a deficit in the identification of emotions. Moreover, since only the DIE sub-scale was related to cognitive performance (see below), this suggests that rehabilitation efforts should be focused on remediation of this specific deficit.

#### 4.2. Executive functioning and alexithymia

TBI patients were substantially impaired on all measures of fluency as indexed by moderate to large effect sizes, although the phonemic fluency deficit just failed to attain significance. As noted earlier, this is the first study to assess alternating fluency performance in relation to TBI. Downes, Sharp, Costall, Sagar and Howe (1993) suggest that alternating fluency tasks are characterised in terms of the abstract algorithms that determine search parameters, and which guide the search for particular exemplars related to the fluency probe. The present results suggest that TBI patients may have difficulty in implementing the abstract algorithms underlying performance as they were substantially more impaired on the

alternating fluency measure than on either phonemic or semantic fluency.

Alexithymia is considered by some to be a disorder of affect regulation (Taylor et al., 1997). Thus, if changes in the regulation of emotions following TBI reflect a similar set of control mechanisms to those involved in executive functions it would be predicted that measures of both types of process would be related. Current results indicate that difficulty in identifying emotions is consistently negatively correlated with performance on all of the fluency measures, although only the correlations between semantic fluency and alternating fluency attained significance. Fluency measures are considered to tap a range executive control processes, including those responsible for the organisation of verbal retrieval and recall, self-monitoring aspects of cognition and effortful self-initiation (Crawford & Henry, 2005; Ruff, Light, Parker, & Levin, 1997). However, it might be argued that since tests of phonemic fluency also impose substantial demands upon verbal intelligence (Miller, 1984; Henry & Phillips, *in press*), and the DIE sub-scales require the ability to symbolize emotion in the verbal domain, it may be this shared characteristic that underlies the correlations observed, and not an overlap in cognitive and emotional control processes.

Evidence against this possibility is the consistently weak associations between the TAS-20 DDE sub-scales with each of the fluency measures, which presumably imposes stronger demands upon verbal expression than the DIE sub-scale. Moreover, as noted earlier, Lane et al. (2000) suggest that emotion recognition deficits do not simply reflect a deficit in the capacity to symbolize emotion, but a more general deficit in the capacity for emotion information processing. It is therefore suggested that the present results provide preliminary evidence of an association between cognitive and emotional dysfunction, which may reflect a common neuropsychological deficit. This might have implications for the rehabilitation of emotional processing problems in TBI: attempts to assess and treat emotional dysfunction may have to consider the role of cognitive variables too.

Finally, the number of participants with specific types of brain damage was not large enough to include an analysis of each variable against the locus of injury. Nevertheless, anecdotally it is of interest that there was a clear trend for the nine patients with documented frontal damage to perform more poorly on each of the fluency measures relative to the nine patients without frontal damage. Further, frontal brain damaged patients also presented with increased alexithymia as indexed by the Total, DIE and DDE sub-scales of the TAS-20 (the two sub-groups did not differ on the EOT dimension), and the difference between the two sub-groups was largest for the DIE dimension ( $M = 18.8$  versus  $15.4$ , respectively). DIE was also more strongly correlated with semantic and alternating fluency in frontal relative to non-frontal brain damaged patients (correlations between DIE and FAS fluency were equivalent across these two sub-groups). As noted previously, alexithymia has been linked to abnormalities in the prefrontal cortex (Berthoz et al., 2002; Gundel et al., 2004;

Kano et al., 2003); these observations are therefore consistent with this empirical research.

#### 4.3. Limitations of the current study and future research

Since its development the TAS-20 has almost exclusively been used in the assessment of alexithymia for both research and clinical practice, and indeed all three previous studies that have investigated the relationship between alexithymia and TBI have used the TAS-20 to do so (Becerra et al., 2002; Williams et al., 2001; Allerdings & Alfano, 2001). However, as noted, with the exception of Becerra et al. (2002) single case study none of these studies reported scores on the individual sub-scales. It was therefore considered important to use the TAS-20 to index alexithymia in the present study to cross-validate this earlier research, but with the additional goal of precisely delineating which aspects of alexithymia are affected by the disorder.

Nevertheless, a limitation of the present study is that only a single measure of alexithymia was used. Further, the TAS-20 is a self-report measure of alexithymia, and this was used in combination with other self-report measures. An important area of future research is therefore to validate these findings using other measures of alexithymia, and in particular, with objective behavioural measures such as observer ratings, or the LEAS. Before any self-report measure can be used with confidence, convergent validity must be demonstrated with more objective, behavioural measures. However, it should be reiterated that the present results (which documented a particular deficit in the identification of TBI patients' own emotions) are entirely consistent with other behavioural studies which have demonstrated TBI to be associated with a decreased capacity to recognise emotions in others (Hopkins et al., 2002; Jackson & Moffat, 1987; McDonald & Pearce, 1996; Milders et al., 2003).

Finally, whilst the present study indicates a clear relationship between alexithymia and TBI, it cannot address the issue of causality. To do so would require alexithymia, mood and well being to be assessed longitudinally following a TBI. Thus, whilst it may be the case that alexithymia is caused by brain injuries, a different possibility would be that brain injuries cause depressive symptoms or anxiety, which then might be responsible for elevated alexithymia scores. Alternatively, it may be that brain injury causes increased alexithymia which in turn also causes depressive symptoms or anxiety. We would encourage empirical investigation of this issue. Nevertheless, irrespective of which of these possibilities is correct the present study has documented a clear relationship between alexithymia and TBI, which cannot be entirely accounted for by increased negative affectivity.

## 5. Conclusions

Patients with TBI present with elevated levels of alexithymia as indexed by an increased difficulty identifying emo-

tions. In terms of practical implications, these results suggest that rehabilitation efforts should be focused on remediation of this specific deficit, particularly since DIE made a significant contribution to QOL that was independent of anxiety and depression. Whilst patients also present with an increased predilection to engage in externally oriented thinking, this was unrelated to measures of mood and well being. Although studies typically focus on aspects of cognitive change following head injury, these results lend support to Becerra et al.'s (2002) notion of an 'organic alexithymia', and suggest that more attention should be focused upon assessment of emotional change post-head injury.

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