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Basic emotion profiles in healthy, chronic pain, depressed and PTSD individuals

Anne M. Finucane[1,*], Alexandra Dima[2], Nuno Ferreira[2] and Marianne Halvorsen[3]
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1 School of Philosophy, Psychology and Language Sciences, University of Edinburgh, Edinburgh, UK
2 School of Health in Social Science, University of Edinburgh, Edinburgh, UK
3 Department of Psychology, University of Tromso, Tromso, Norway

Email: Anne M. Finucane (anne_finucane@yahoo.ie)
*Psychology, PPLS, University of Edinburgh, 7 George Sq., Edinburgh, EH8 9JZ

Abstract

Objectives
To compare self-reports of five basic emotions across four samples: healthy, chronic pain, depressed and PTSD, and to investigate the extent to which basic emotion reports discriminate between individuals in healthy or clinical groups.

Methods
In total, 439 participants took part in this study: healthy ($N = 131$), chronic pain ($N = 220$), depressed ($N = 24$) and PTSD ($N = 64$). Participants completed the trait version of the Basic Emotion Scale (Dalgleish & Power, 2004). Basic emotion profiles were compared both within each group and between the healthy group and each of the three other groups. Discriminant analysis was used to assess the extent to which basic emotions can be used to classify participants as belonging to the healthy group or one of the clinical groups.

Results

In the healthy group, happiness was experienced more than any other basic emotion. This was not found in the clinical groups. In comparison to healthy participants, the chronic pain group experienced more fear, anger and sadness; the depressed group reported more sadness; and the PTSD group experienced all of the negative emotions more frequently. Discriminant analysis revealed that happiness was the most important variable in determining whether an individual belonged to the healthy group or one of the clinical groups. Anger was found to further discriminate between depressed and chronic pain individuals.

Conclusion

The findings demonstrate that basic emotion profile analysis can provide a useful foundation for the exploration of emotional experience both within and between healthy and clinical groups.

Key Practitioner Message

- More frequent experiences of happiness relative to discrete negative emotions most clearly discriminate between individuals in healthy and clinical groups. More frequent anger experiences further discriminate between individuals with chronic pain and those with depression while disgust levels help discriminate between those with PTSD and depression.

- More frequent experiences of high arousal negative emotions – fear, anger and disgust are characteristic of individuals with PTSD.

- Fear is the most frequently experienced negative emotion in both healthy and clinical groups. Higher levels of fear compared to other discrete negative emotions are not necessarily an indicator of psychopathology. Consideration of emotional profiles more generally and the relative frequency with which happiness is experienced relative to negative emotions may be more useful in delineating between healthy individuals and those with chronic pain, depression or PTSD.

Although emotions play an important role in psychopathology, few studies have applied models of everyday emotions to research in psychopathology. Nonetheless, the frequency of everyday emotions is a useful starting point for understanding patterns of emotional experience that discriminate between emotional order and disorder (Dalgleish & Power, 2004). In particular, the assessment of everyday basic emotions in healthy and clinical groups may help build a richer picture of an individual's emotional landscape and have implications for therapeutic interventions.

The term 'basic emotion' is generally associated with functionalist accounts of emotion that emphasize the adaptive value of emotions in dealing with fundamental life tasks (Ekman, 1999; Lazarus, 1991). Happiness, sadness, anger, fear and disgust are frequently identified as basic emotions (Dalgleish & Power, 2004; Ekman, 1992; Izard, 1991; Oatley & Johnson-Laird, 1987). According to Ekman (1999), basic emotions differ from one another, and from other affective phenomena in terms of their physiological and behavioural characteristics as well as the type of appraisals or subjective evaluations that occur when a basic emotion is experienced.

Drawing on Oatley and Johnson-Laird (1987), Power and Dalgleish (2004) identified five basic emotions that can be distinguished from each other in terms of the type of appraisal associated with each. These are happiness, sadness, anger, fear and disgust. Happiness reflects the appraisal that progress towards a valued goal is being made, sadness occurs when a significant event signals loss or failure; anger occurs when a goal is blocked or frustrated; fear results from a physical or social threat to the self or to a valued goal; while disgust occurs when the situation presents a person or object repulsive to the self and to valued goals. Power and Dalgleish (2004; 2008) have proposed a multi-level framework – SPAARS (Schematic, Propositional, Analogical and Associative Representation Systems) – as a basis for understanding emotion. According to the SPAARS model, these five appraisal-based emotions are the building blocks of emotional life: both emotional order and emotional disorder can be derived from these basic components.

The model stipulates four distinct interacting levels of emotion processing. Emotional stimuli are initially processed by the Analogical representation system via sensory-specific modules. The output of the Analogical system is further processed in parallel by three systems: Associative, responsible for the automatic elicitation of emotion; Schematic, which generates emotion via effortful appraisal; and an intermediary Propositional system, which participates indirectly in emotion

generation via its connection with the Associative and Schematic systems. According to SPAARS, emotional disorder may be due to the coupling of two or more basic emotions, to the coupling of different processing levels within the same emotion, or to the inhibition of emotion at the Schematic level. Feedback loops may develop between or within the basic emotion modules, and maintain, exacerbate or inhibit emotional experiences, thus changing the individual's emotion profile (Power, 2005; Power & Dalgleish, 2008).

The aim of the present study was to compare basic emotion profiles across four samples – healthy, chronic pain, depressed and PTSD. Although data for each sample was collected as part of separate projects, the basic emotion profiles have not been compared until now. The current study had three overarching purposes: (i) To examine the relative distribution of self-reported emotion experience within each group. (ii) To compare the basic emotion profiles characterising the healthy group with the clinical groups (chronic pain, depressed, PTSD). (iii) To examine the extent to which basic emotions can predict whether an individual belongs to a healthy or clinical group.

Our first prediction was that the healthy sample would report more frequent happiness than any other emotion, and more happiness compared with any of the other groups. Healthy populations are characterised by high levels of subjective well-being and experience more frequent and intense positive emotions compared to negative emotions (Zelenski & Larsen, 2000). Healthy individuals are thought to have a positive baseline level of affect to which they return after a new positive or negative affective experience (Diener & Diener, 1996). A positive set-point is advantageous as it allows negative events to stand out against a positive affective background.

It was predicted that individuals in the chronic pain sample would report higher levels of anger, sadness and fear in comparison to the healthy sample. Emotion is considered one of the three components of pain experience, together with the sensory and evaluative dimensions (Melzack & Katz, 2001). Beyond its intrinsic unpleasantness, the emotional response to pain is particularly related to anger, fear and sadness (Fernandez & Milburn, 1994). Both anger expression and anger suppression have been linked with pain severity via various physiological mechanisms (e.g. Bruehl, Chung, Burns, & Biridepalli, 2003; Burns, Kubilus, & Bruehl, 2003; Burns, Quartana, & Bruehl, 2008). Fear of pain has been shown to be

closely related to various measures of patient functioning in chronic pain (Crombez, Vlaeyen, Heuts, & Lysens, 1999; McCracken, Zayfert, & Gross, 1992), as has anxiety sensitivity (Keogh & Cochrane, 2002) and worry (Eccleston & Crombez, 1999). Shame and positive emotions have been reported as less frequent in chronic pain (Fernandez & Milburn, 1994) although research suggests they too may play important roles (Jackson, 2005; Zautra, Johnson, & Davis, 2005). High levels of depression has also been found in chronic pain populations with an estimated 34% to 54% of chronic pain patients suffering from Major Depressive Disorder (MDD) at any given point in time (Banks & Kerns, 1996) further suggesting that sadness will be characteristic of this group.

Given the centrality of sadness in MDD, it was predicted that depressed individuals would experience more sadness than any other emotion, and more sadness compared with individuals in the healthy sample. According to the APA (2000), a major depressive episode is characterised by a 2-week period of persistent sad mood and/or a loss of pleasure in daily activities. Individuals diagnosed with MDD reliably report low levels of positive affect and higher levels of negative affect on a range of questionnaire measures (APA, 2000; Clark, Watson, & Mineka, 1994). Thus, in conjunction with sadness, depressive disorders tend to be associated with a reduction in positive affective experiences. Therefore, it was also predicted that individuals in the depressed group would report less frequent happiness experiences compared to those in the healthy group.

Post-traumatic stress disorder (PTSD) refers to a particular set of emotional and psychological sequelae that occur following an event that gives rise to feelings of "intense fear, helplessness or horror"(DSM-IV: APA, 2000 p.428). According to the SPAARS account of PTSD, the symptom clusters are related to a persistent failure of the cognitive system to assimilate and accommodate trauma-related information with pre-existent mental representations of the self and reality, independent of the emotional response associated with the original event (Dalgleish, 2004; Dalgleish & Power, 2004). Therefore a myriad of emotions at the onset of trauma, other than "intense fear, threat or horror" as proposed by the DSM-IV could lead to the same cognitive dissonant reaction. Several studies have supported this theoretical account by linking the experience of sadness, anger and disgust with PTSD (Budden, 2009; Dalgleish & Power, 2004; Van Vliet, 2008). It was therefore predicted that individuals in the PTSD sample would report higher levels of fear, anger, sadness and

disgust compared with happiness, and that they would report more frequent experiences of each of the negative emotions compared with the healthy group.

Hypotheses

To summarise, basic emotion reports were compared both within each sample (i.e. the relative frequency with which each emotion was experienced) as well as between the healthy (control) sample and each of other samples. It was predicted that:

1. Healthy individuals would report more frequent experiences of happiness compared with any other emotion, and more frequent happiness compared with any other groups.
2. Individuals in the chronic pain sample would report more frequent anger, fear and sadness in comparison to the healthy group.
3. Individuals in the depressed sample would report more frequent sadness than any other emotion. They would also report more sadness and less happiness in comparison to the healthy group.
4. Individuals in the PTSD sample would report higher levels of fear, anger, sadness and disgust compared with happiness. They would also report more frequent experiences of each of the negative emotions compared with the healthy group.

Method

Participants and procedures

Group 1: Healthy

The healthy group consisted of 131 first year students (72% female) from the University of Edinburgh who completed the Basic Emotions Scale (BES) as part of a separate study. The data was collected via a computer monitor in a small quiet cubicle in the Psychology department of the University of Edinburgh.

Group 2: Chronic pain

The chronic pain group consisted of 220 participants (68% female). One-hundred and ninety-two participants were recruited from the NHS Lothian Chronic Pain Centre via face-to-face meetings in the outpatient centre waiting room or via postal questionnaires. Twenty-eight participants were recruited from support groups organized by Pain Association Scotland. Participants in the chronic pain group completed the BES as part of a more comprehensive survey on emotions and chronic

pain. The survey was mailed to participants who then completed it at home and returned it to the researcher in a pre-paid envelope.

Group 3: Depressed

The depressed group consisted of a sample of 24 Norwegian participants (71% female) who completed the BES as part of a wider study (See Halvorsen *et al.*, 2009). Participants were recruited through general practitioners and local newspaper adverts. Before selection for study participation, candidates completed the Beck Depression Inventory (BDI-II: Beck, Steer, & Brown, 1996). Respondents with a BDI-II score above 14 (i.e. potentially clinically depressed) were subsequently invited to take part.

All study participants were subsequently diagnosed with a Major Depressive Episode according to the DSM-IV (DSM-IV-TR; APA, 2000) using the Structured Clinical Interview for Axis I Disorders (SCID Clinical Version: First, Spitzer, Gibbon, & Williams, 1997). The mean BDI-II score for the group was 24.79 ($SD = 9.97$). None of the participants were being treated as an inpatient at the time of the assessment. Seven of the participants were on antidepressant medications.

Participants completed a Norwegian translation of the Basic Emotions Scale (BES). The translation from the English version followed established guidelines including appropriate use of independent back translations (Sartorius & Kuyken, 1994) and was found to be an internally consistent and factor-analytically valid instrument (Halvorsen & Power, 2009).

Group 4: Post-traumatic stress disorder

The PTSD sample ($n = 64$) was drawn from 109 patients (41% female) who had been referred to the Edinburgh Traumatic Stress Centre. All patients completed the BES as part of a questionnaire pack received prior to initial face-to-face assessment. PTSD diagnosis was subsequently confirmed through the use of both a clinical interview by therapists specialized in PTSD and by the use of the Impact of Events Scale – Revised (IES-R:Weiss & Marmar, 1997). Sixty-four of the initial 109 patients were subsequently diagnosed with PTSD. Problem onset ranged from 2 months to 33 years with an average of 68.35 months. Although nationality was not recorded, most users of this medical centre are British.

Basic Emotions Scale

The trait version of the Basic Emotions Scale consists of 20 emotion word items that assess how frequently an individual experiences each of five basic emotions: happiness, sadness, anger, fear and disgust. Participants are asked to rate how frequently they experience each item in general using a 7-point scale where 1 indicates 'never' , 4 indicates 'sometimes' and 7 indicates 'very often':

Happiness: Happiness, Joy, Loving, Cheerful

Sadness: Despair, Misery, Gloominess, Mournful

Fear: Anxiety, Nervousness, Tense, Worried

Anger: Anger, Frustration, Irritation, Aggression

Disgust: Shame, Guilt, Humiliated, Blameworthy.

Previous studies have shown that each sub-scale has high internal consistency (Dalgleish & Power, 2004). In the present study good levels of internal consistency were also found for each of the sub-scales within each of the four samples. For all participants, irrespective of sample, Cronbach reliabilities ranged from .84 (anger) to .92 (happiness) for each sub-scale. Within each sample, the Cronbach alphas were: .76 to .89 (healthy), .82 to .90 (chronic pain), .70 to .86 (depressed) and .74 to .87 (PTSD).

Results

Data analysis

A mean basic emotion score ranging from 1 to 7 for each of the five emotions was calculated for each participant. In cases where data for one item was missing, the mean score for that participant was based on three as opposed to four items. 92% of participants had no missing values.

Basic emotion scores were compared within each sample to determine the relative frequency of each emotion. Given the non-normal distributions, non-parametric tests were used (Wilcoxon signed rank test). Emotion profiles were also compared between samples using the Mann-Whitney *U* test. Emotion scores of the chronic pain, depressed and PTSD groups were each compared against the healthy group which was used as a control. Effect sizes (*r*) were calculated in accordance

with Field (2005, p.532) as the z score of the test statistics divided by the square root of the total number of observations. Finally, discriminant function analysis was conducted to determine the degree to which basic emotions data could be used to correctly classify participants into the healthy and clinical groups.

Table 1: Descriptive data across each sample

	Healthy	Chronic Pain	Depressed	PTSD	Total
N	131	220	24	64	439
% Female	72%	68%	71%	41%	65%
Age (*M*)	20.44	50.84	38.38	37.16	38.95
Age (*SD*)	6.01	11.09	11.92	10.99	16.45
Nationality	UK /Irish 79%	UK /Irish 95%	Norwegian 100%	*Mostly British*	

Descriptive data

There were significant differences in age across the four samples, $F(3, 434) = 250$, $p < .001$ (Table 1). Participants in the healthy group were significantly younger than participants in any of the other groups. In addition, participants in the chronic pain group were older than any of the other groups. Participants in the depressed and PTSD samples were of similar age. There were also significant differences in the gender distribution across the four samples, $\chi^2 = 20.8$, $p < .001$. The gender differences were mainly due to the PTSD group which contained more males (59.4%) than females. In all other samples, females accounted for between 68.2% and 71.8% of each sample.

Table 2: Basic emotion scale scores in each sample

		Happy	Fear	Anger	Sad	Disgust
Healthy	*Mdn*	5.75	4.00	3.25	2.50	2.25
	M	5.66	3.94	3.39	2.60	2.59
	SD	0.86	1.24	0.92	1.06	1.04
Chronic Pain	*Mdn*	5.00	4.75	4.38	3.50	2.60
	M	4.86	4.64	4.42	3.62	2.91
	SD	1.19	1.30	1.26	1.49	1.43
	p	<.001	<.001	<.001	<.001	.13
Depressed	*Mdn*	3.63	4.25	3.75	3.50	2.60
	M	3.56	4.35	3.86	3.59	2.79
	SD	1.17	1.30	1.20	1.04	1.27
	p	<.001	.11	.08	<.001	.46
PTSD	*Mdn*	3.25	6.00	5.38	3.50	4.75
	M	3.26	5.77	5.28	4.95	4.50
	SD	1.28	0.96	1.24	1.31	1.59
	p	<.001	<.001	<.001	<.001	<.001

p-values: based on the comparison between the healthy (control) group and the chronic pain, depressed and PSTD groups (Bonferroni correction applied).

Basic emotion scale data

Healthy sample

Individuals in the healthy group reported experiencing happiness more frequently than any other emotion (all *p*'s <.01). The most frequently experienced negative emotion was fear which was experienced significantly more often than anger, sadness and disgust (all *p*'s <.01). Anger was experienced more frequently than sadness and disgust (*p*'s <.01). However, there was no difference in the frequency with which sadness and disgust were reported (Table 2). Figure 1 shows the emotion profile of healthy group compared to those in the chronic pain, depressed and PTSD groups.

Chronic pain sample

Individuals in the chronic pain group experienced happiness more frequently than anger, sadness and disgust (all *p*'s <.01). However, there was no significant difference in the frequency of happiness (*Mdn* = 5.0) and fear (*Mdn* =4.75). Like those in the healthy group, individuals in the chronic pain group reported that they

experienced fear significantly more frequently than any other negative emotion (all p's <.01). Anger was experienced more often than sadness and disgust, while disgust was experienced significantly less frequently than any other emotion.

In comparison to the healthy group, the chronic pain group experienced happiness less often, $U = 8630, p < .001, r = .34$. They also experienced fear ($U = 10112, p <.001, r = .25$), anger ($U = 7539, p < .001, r = .4$) and sadness ($U = 8579, p < .001, r = .34$) more often. There was no difference in the frequency of disgust experiences in the healthy and the chronic pain samples.

Depressed sample

In the depressed group, fear was experienced more frequently than happiness ($z = -2.04, p = .04$) and there was a non-significant trend towards more frequent anger experiences compared with happiness ($z = -1.76, p = .08$). There was no significant difference in the frequency of happiness experiences compared with sadness or disgust (Table 2). Fear ($Mdn = 4.25$) was experienced significantly more frequently than sadness ($Mdn = 3.5$) and disgust ($Mdn = 2.6$). Fear and anger were also experienced more frequently than sadness (both p's < .01). Disgust was experienced less frequently than any other negative emotion (all p's <.01).

In comparison to the healthy group, the depressed group experienced happiness less often ($U = 232, p <.001, r =.53$) and sadness more often ($U = 729, p < .001, r = .34$). There was a non-significant trend suggesting more frequent anger experiences in the depressed group ($U =1219, p = .08, r = .14$). There was no difference in the reported frequency of fear and disgust.

PTSD sample

In the PTSD sample, participants reported significantly fewer happiness experiences compared with any other emotion (all p's <.01). Individuals in this group experienced fear ($Mdn = 6.0$) significantly more often than any other emotion (all p's <.01). Following fear, anger was experienced most often ($Mdn = 5.38$).

The PTSD group experienced each of the negative basic emotions more frequently than the healthy group: fear ($U = 1053, p < .001, r = .61$), anger ($U = 1007, p < .001, r = .62$), sadness ($U = 755, p < .001, r = .67$) and disgust ($U = 1004, p < .001, r = .54$). They also experienced happiness a lot less frequently ($U = 551, p < .001, r = .71$).

Figure 1: Basic emotion profiles by sample
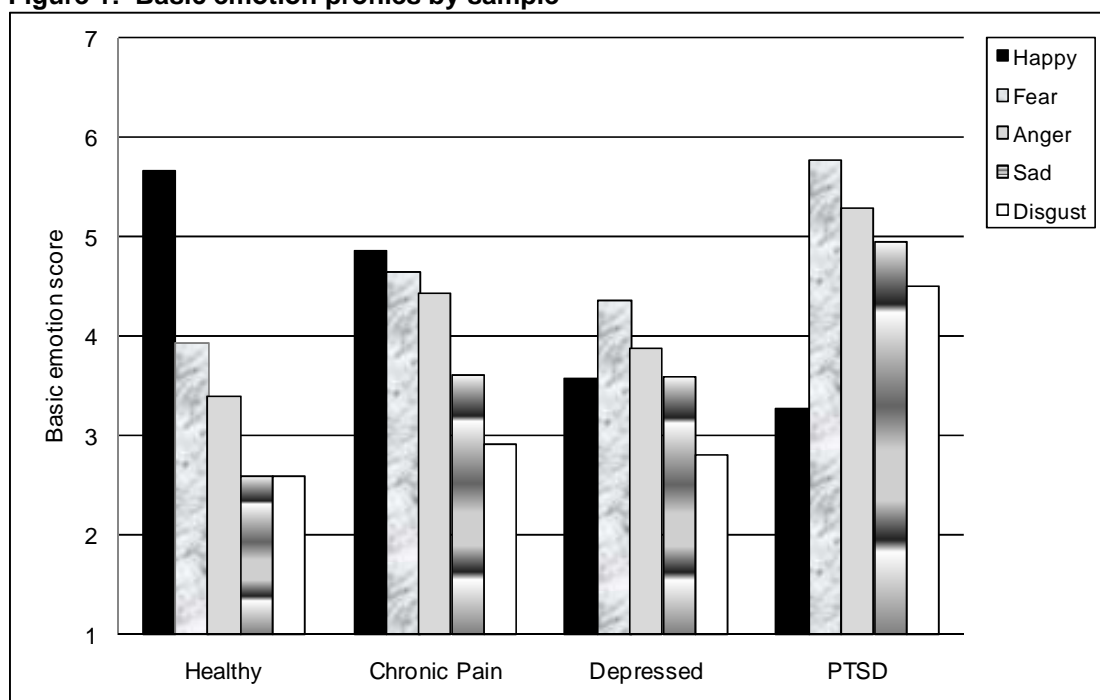
Discriminant function analysis

Discriminant function analysis (DFA) can be used to find the dimensions along which groups differ and to find classification functions to predict group membership. DFA was conducted as part of the present study to determine the degree to which dimensions or functions derived from our basic emotion data could be used to classify participants into the healthy and clinical groups.

The analysis was performed using the five basic emotions as predictors of membership of the healthy, chronic pain, depressed or PTSD groups. Three discriminant functions were calculated with a combined $\chi^2(15) = 278$, $p < .001$ indicating a relationship between the four groups and the basic emotion scale predictors that is highly unlikely to be due to chance. After removal of the first function, there was still an association between groups and predictors, $\chi^2(8) = 70.6$, $p < .001$ indicating that this second function is also relevant. A third function was also found to have a further significant contribution to make to distinguishing between the four groups, $\chi^2(3) = 27.7$, $p < .001$ The three discriminant functions accounted for 78.4%, 13.2% and 8.4% respectively of the between-group variability.

Discriminant functions form axes and the centroids of each group can be plotted along these axes. If there is a big difference between the centroid of one group and the centroid of another along a discriminant function axes, the discriminant function separates the two groups (Tabachnick & Fidell, 2007). In the present study,

the first discriminant function maximally separated the healthy group from the chronic pain, depressed and PTSD groups. The second function maximally separated the depressed from the chronic pain group while the third function maximally separated the depressed and PTSD groups.

The structure matrix (i.e. the loading matrix) shows the correlations or loadings between the group predictors (i.e. happiness, sadness, anger, fear and disgust) and each of the discriminant functions (Table 3). The meaning of the function can then be inferred from the pattern of loadings. The loading matrix showed that the best predictor for distinguishing between the healthy group and the clinical groups (Function 1) was happiness ($r = .91$), followed by sadness ($r = -.70$), anger ($r = .63$) and then fear ($r = -.57$). The loading matrix also shows that the second function, which maximally distinguishes between the chronic pain and depressed group, correlates most highly with anger ($r = .66$). Thus heightened levels of anger best distinguish between those in the chronic pain sample from individuals in the other groups after the between-group variance has been accounted for by the first function. The third function correlated most highly with disgust ($r = .79$) and maximally distinguished between the depressed and PTSD groups. This indicates that those in the PTSD group are best distinguished from individuals in the other groups by their heightened experiences of disgust after the between-group variance has been accounted for by the first and second functions.

Table 3. Discriminant function analysis: Structure matrix

	Function		
	1	2	3
Happiness	**.914**	.328	.220
Sadness	-.703	.314	.246
Fear	-.567	.274	.461
Anger	-.631	**.657**	.302
Disgust	-.530	-.118	**.786**

Note. Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions.

The degree to which the three functions could determine whether a specific individual belonged to the healthy, chronic pain, depressed or PTSD group was examined using classification analysis. This type of analysis classifies each member

of the total sample ($N = 439$) into either the healthy, chronic pain, depressed or PTSD group, based on the three discriminant functions shown in Table 3. The sample consisted of 131 healthy participants (.30 of the total), 220 from the chronic pain group (.50 of the total sample), 24 from the depressed group (.055 of the total sample) and 64 from the PTSD group (.15 of the total sample). Thus, the number of individuals that would be classified correctly due to chance alone was: (131 x .30) + (220 x .50) + (24 x .06) + (64 x .15) = 160 individuals (36% of the total sample). Our results showed that 61.5% of individuals who were classified into one of the four groups based on our discriminant functions were correctly classified (Table 4). This is substantially higher than the classification level expected by chance alone (36%). 58% of those in the healthy group were correctly classified compared with 30% due to chance alone (healthy participants made up 30% of the total sample). 72% of those in the chronic pain group were correctly classified – a much higher proportion than would be correctly classified based on chance alone (50%). 16.7% of those in the depressed group were correctly classified as belonging to the depressed group compared with 5.5% based on chance alone. 48% of those in the PTSD group were correctly classified; again a much higher proportion than would have been correctly classified based on chance alone (15%). This suggests that the classification of individuals into the appropriate group – healthy, chronic pain, depressed or PTSD – based the three emotion functions (Table 3) was effective (Table 4).

A closer look at the classification results shows that the biggest error in classification occurred between the depressed and the chronic pain groups. 62.5% of the depressed group were classified as belonging to the chronic pain group (12.5% higher than that which would occur by chance). 9% of the chronic pain group were classified as depressed (compared with 5.5% due to chance).

To cross-validate the results the classification analysis was rerun. This time each of the 439 individuals were classified into one of the four groups based on the functions derived from all other individuals other than themselves. 59.7% of the cases cross-validated in this manner were correctly classified, further suggesting that the functions effectively classify individuals into the group to which they belong (Table 4).

Table 4. Classification results[a,b]

		Group	Depressed	Healthy	Chronic Pain	PTSD	Total
			Predicted Group Membership				
Original	Count	Depressed	4	1	15	4	24
		Healthy	0	76	54	1	131
		Chronic pain	2	44	159	15	220
		PTSD	1	1	31	31	64
	%	Depressed	16.7	4.2	62.5	16.7	100.0
		Healthy	.0	58.0	41.2	.8	100.0
		Chronic pain	.9	20.0	72.3	6.8	100.0
		PTSD	1.6	1.6	48.4	48.4	100.0
Cross-validated	Count	Depressed	4	1	14	5	24
		Healthy	0	72	58	1	131
		Chronic pain	2	46	155	17	220
		PTSD	1	1	31	31	64
	%	Depressed	16.7	4.2	58.3	20.8	100.0
		Healthy	.0	55.0	44.3	.8	100.0
		Chronic pain	.9	20.9	70.5	7.7	100.0
		PTSD	1.6	1.6	48.4	48.4	100.0

Note. The number of cases that would be correctly classified due to chance alone is 36% of the total sample (5.5% of the depressed group, 30% of the healthy group, 50% of the chronic pain group and 15% of the PTSD group). [a] 61.5% of the original groups correctly classified [b] 59.7% of the cross-validated cases correctly classified.

Discussion

These results demonstrate that basic emotion profiles differ significantly in healthy individuals compared to those with chronic pain, depression or PTSD. Furthermore, the results provide initial evidence that basic emotions scores can be used to distinguish healthy individuals from those with depression or PTSD.

Our first hypothesis; that healthy individuals will report more frequent experiences of happiness compared with any other emotion and more happiness experiences than any other group, was supported. This fits with previous research suggesting that in general people are fairly happy and report more positive compared with negative affective experiences (Diener & Diener, 1996; Lucas, Clark, Georgellis, & Diener, 2003). Frequent experiences of positive emotion states such as happiness have important physical and psychological benefits. In a comprehensive meta-analytical study Lyubomirsky, King and Diener (2005) found that frequent experiences of positive affective states engender success, and that happiness is both associated with, and precedes, successful outcomes in work, health and social relationships. According to the broaden-and-build theory of positive emotion,

positive emotions facilitate creative and divergent thinking (Fredrickson, 2003; Fredrickson & Branigan, 2005; Isen, 1999) and undo the negative effects of negative emotions (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000; Tugade & Fredrickson, 2004). Frequent experiences of positive emotions build personal and social resources over time and help individuals to cope with adverse events (Tugade, Fredrickson, Waugh, & Larkin, 2003).

Markedly higher levels of happiness compared to any of the negative emotions are only found in the healthy group. The chronic pain group did not experience happiness any more often than fear, and there was no difference in the perceived frequency of happiness compared with other negative emotions in the depressed group. In the PTSD group happiness was experienced less frequently than any of the negative emotions highlighting greatest emotional disturbance in this group. The discriminant analysis showed that happiness had the greatest contribution to make in determining whether an individual is classified as belonging to a healthy or to clinical group (in particular depression or PTSD) further highlighting the importance of happiness as a marker of psychological health.

Our second hypothesis; that individuals in the chronic pain group would report more frequent experiences of anger, fear and sadness in comparison to the healthy group was supported, confirming Fernandez and Milburn's (1994) results regarding a higher association between these three emotions and pain-related emotional distress. The higher frequency of fear-related emotions is in accord with the central role of fear, anxiety and worry in pain management (Eccleston & Crombez, 1999; Keogh & Cochrane, 2002; McCracken et al., 1992).

Individuals in the chronic pain group reported less frequent happiness experiences compared with healthy individuals. Fewer happiness experiences and more frequent sadness was found in both the chronic pain and depressed group, which supports previous research suggesting that depression is prevalent in chronic pain (e.g. Banks & Kerns, 1996). There is evidence that positive affect attenuates the relationship between chronic pain and negative affect and helps build pain resilience (Zautra, Smith, Affleck, & Tennen, 2001; Zautra et al., 2005). Consequently, emotion-focused interventions that focus on increasing positive emotional experiences and treating depression where necessary in chronic pain sufferers may build resilience and reduce perceived pain interference in this group.

The co-occurrence of depression and chronic pain is also suggested by the results of our DFA which showed that a greater proportion of individuals in the depressed group were categorised as belonging to the chronic pain group and vice versa, compared to what would be expected by chance alone. Several hypotheses may account for this similarity in emotional profiles, such as a common pathological mechanism (e.g. Blackburn-Munro & Blackburn-Munro, 2001), depression history as a vulnerability factor to increased pain perception (e.g. Conner et al., 2006), or the mediating role of cognitive-behavioural factors (e.g. Rudy, Kerns, & Turk, 1988). Notably, our second function shows that heightened levels of anger are more characteristic of chronic pain sufferers and helps distinguish them from the other groups. Although our analysis identified fear as the most frequent negative emotion in chronic pain sufferers, other studies reported anger and frustration as the most intense emotions concomitant to pain (Fernandez & Milburn, 1994). According to Fernandez and Turk (1995) and consistent with the SPAARS model, pain may generate anger either via an immediate, automatic pathway due to its sensory properties or via cognitive appraisals of goal obstruction or mistreatment in relation to the direct cause of injury, the medical and legal systems, significant others or self. Thus the heightened levels of anger that discriminate this group from the others confirm the representativeness of anger for chronic pain and the importance of including anger regulation strategies within pain management programmes.

Our third hypothesis; that individuals in the depressed sample would report more sadness than any other emotion and more sadness in comparison to healthy individuals, was only partially supported. In contrast to our prediction, fear and anger were experienced more frequently than sadness. Several explanations might be considered. First, anxiety and depression are often comorbid conditions (Hettema, 2008) and trait anxiety may be a vulnerability factor for depression (Sandi & Richter-Levin, 2009). Second, sadness can be readily experienced with other emotions (Dalgleish & Power, 2004). Third, fear and anger were experienced more often than sadness and disgust in all samples, perhaps reflecting Zelenski and Larsen's (2000) findings based on an experience sampling study that sadness is experienced less frequently than anxiety and anger. Alternatively it may be that incidences of commonplace high arousal negative emotions such as fear and anger are remembered more clearly than events which elicit low arousal emotions. In line with our hypothesis, sadness occurred more frequently for individuals in the depressed group

in comparison to those in the healthy group. There was a non-significant trend suggesting more frequent anger in the depressed group compared with the healthy group. These patterns broadly replicate those reported previously (Dalgleish & Power, 2004).

Our fourth hypothesis; that individuals in the PTSD group would report each of the negative emotions more frequently than happiness, was supported, as was our hypothesis that PTSD individuals would report more of each of the negative emotions in comparison to the healthy group. The profile of basic emotions in the PTSD group was a mirror-image of that of the profile of basic emotions in the healthy group suggesting significant emotional disturbance. Intense fear experiences are characteristic of PTSD, as it occurs in response to a traumatic event in which the individual experienced intense fear or helplessness. The event is often re-experienced on exposure to internal or external cues together with intense psychological distress (Dalgleish & Power, 2004; Gershuny, Cloitre, & Otto, 2003; Jovanovic et al., 2009; Price, Monson, Callahan, & Rodriguez, 2006). Increased physiological arousal including irritability, hyperarousal, anger and hypervigilence are also associated with PTSD (APA, 2000). Heightened levels of anger in PTSD have also been found in previous studies (Andrews, Brewin, Rose, & Kirk, 2000; Olatunji, Ciesielski, & Tolin, in press). In particular, anger control, the tendency to express anger inwards and the tendency to express anger through verbal or physical behaviour have been found to distinguish individuals with PTSD from those suffering from more general anxiety disorders. Critically our data also show that the PTSD group experience disgust more frequently than happiness – this is striking given that in most groups disgust is the most infrequently experienced emotion. The high frequency of disgust reported by this group confirms the relevance of disgust-related emotions (including shame and guilt) in PTSD, as highlighted by recent studies (Budden, 2009; Van Vliet, 2008). It also ties in with Budden's (2009) theory that shame underlies peri-traumatic and traumatic experiences of threats to the social self and can play a central role in PTSD.

Despite the relative high levels of fear across all samples, including the healthy sample, it is noteworthy that fear was significantly higher in the chronic pain and the PTSD groups compared with the healthy group. In chronic pain, fear of pain is common and is perhaps even more disabling than pain itself (Crombez *et al.*, 1999). In PTSD, fear of death and fear of losing control play an important role in mediating

the relationship between peritraumatic dissociation and PTSD severity (Gershuny et al., 2003). At a more general level anxiety about the experience of negative emotions may be common to many psychological disorders (Barlow, Allen, & Choate, 2004; Liverant, Brown, Barlow, & Roemer, 2008) and health problems. Consequently, interventions should also focus on reducing fear experiences in individuals suffering from chronic pain and PTSD in particular.

The discriminant analysis showed that basic emotion data can successfully distinguish between healthy individuals and those with chronic pain, depression and PTSD. Happiness was the most important variable in distinguishing between the healthy group and the clinical groups. Although blunted positive affect is generally acknowledged to be a characteristic of depression, positive emotions are often overlooked in studies of other psychopathological disorders. In clinical contexts, explicit consideration of perceived happiness might be helpful in assessing the extent of emotional order or disorder in a patient. The discriminant analysis also suggested that heightened anger scores had the greatest contribution to make in distinguishing between the chronic pain and depressed groups. Strategies to help manage anger could be useful for those with chronic pain, while the expression of anger might be beneficial for those experiencing depression.

Our findings suggest that basic emotion profiles could be used in both assessment and therapeutic intervention. Obtaining information regarding each basic emotion may provide additional insights into the patient's emotional life, and suggest focused interventions that would consider the overall emotion landscape as opposed to selected emotions. Moreover, tracking changes over time in emotion profiles would enable the assessment of interventions at a broader level. Considering both positive and negative emotions in the therapeutic interventions might be particularly useful.

The present study is not without limitations. First, our samples were initially used in separate studies, so it was not possible to match samples in terms of gender, age, size and nationality. In particular, the small size of the depressed sample relative to the other groups may limit the generalizability of the emotion profile findings for this group. However, the finding of higher sadness in the depressed group compared with the healthy group fits with theoretical perspectives. A second limitation related to sampling is that females accounted for only 41% of the PTSD group. While PTSD is more prevalent in men than women, the gender differences across samples give rise to the possibility that higher levels of negative emotions and lower levels of happiness

in the PTSD group may have been due in part to gender. However, females tend to report more frequent experiences of anger, fear and sadness compared to males (Brebner, 2003; Thomsen, Mehlsen, Viidik, Sommerlund, & Zachariae, 2005), suggesting that the emotion profile reported here for PTSD individuals is not due to gender-related patterns of responding. Similarly, although the healthy sample were younger than the other samples, there is much research to suggest that relatively high levels of positive emotions in comparison to negative emotions are characteristic of healthy individuals irrespective of age (Diener & Diener, 1996). Thus, the emotion profile of the healthy group reflects that found in other more representative samples.

This study should be considered as a first exploration of basic emotion profiles, and its results point to the potential usefulness of developing more controlled studies. As the data is based on self-report, it reflects the patients' perceptions of their emotional experiences, which might be biased to a certain extent. These perceptions can be considered a useful starting point in assessment and intervention in conjunction with other approaches. Further analyses could be performed considering specific emotion items in order to test more detailed hypotheses; for example the relationship between shame (but not disgust) and depression (e.g. Dalgleish & Power, 2004), or the consideration of fear and anxiety as distinct emotions (e.g. James & Hardardottir, 2002). The space limitations prevented such analyses, that could however be pursued in further studies.

Conclusion

The present study compared the perceived frequency of basic emotion experiences across four samples. Our findings demonstrate that the experience of basic emotions differs significantly across healthy, chronic pain, depressed and PTSD samples. In particular, our findings show that perceived happiness is important in distinguishing between healthy individuals and those with chronic pain, depression or PTSD. Furthermore, anger levels help discriminate between individuals with depression and those with chronic pain. The BES is a useful research tool as it facilitates assessment of a range of basic emotions in both healthy and clinical contexts. Examination of basic emotion profiles may also be useful in assessing changes in an individual's emotion profile over time. Further research examining use of the BES in applied settings is recommended.

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