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Attention toward Interpersonal Stimuli in Individuals With and Without Chronic Daily Headache

Christina Liossi* and Daniel E. Schoth

Pain Research Laboratory, Academic Unit of Psychology, University of Southampton, Southampton, UK

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***Corresponding author:** Christina Liossi, Pain Research Laboratory, Academic Unit of Psychology, University of Southampton, Highfield, Southampton, SO17 1BJ, UK, Tel: 440-238-059-4645; E-mail: C.Liossi@soton.ac.uk*

Abstract

Attentional capture of threat is a normal and adaptive process, although facilitated processing of mildly threatening stimuli irrelevant to current goals may result in attentional interference and compromised performance. In the field of chronic pain, attentional biases towards pain-related information have been commonly found. Pain is inexorably connected with emotion however, and a transdiagnostic approach elucidating similar mechanisms underlying pain and mood disorders has been advocated. One such mechanism may be repetitive thinking on negative themes, including worry and rumination. Attentional biases for threatening (e.g., angry faces) and negative (e.g., sad faces) information have been observed in anxious and depressed populations, although to date it has not been fully established whether biases for such information are heightened in individuals with chronic pain relative to healthy individuals. In this study, attentional biases for angry, sad and also happy facial expressions, at 500 and 1250 ms presentation times, were assessed via visual-probe task in chronic daily headache (n = 20) and healthy control (n = 26) groups. Results showed participants to demonstrate significant bias towards angry and sad expressions at 500 and 1250 ms, and happy expressions at 1250 ms. No significant differences in attentional bias were found between chronic daily headache and healthy control groups. These results suggest that attentional biases towards interpersonal threat are not specifically heightened in individuals with chronic daily headache. While similar mechanisms such as rumination may underlie biases in different disorders, this does not translate to heightened biases for the same specific content.

Keywords: Chronic headache; Attentional bias; Visual probe task; Interpersonal stimuli; Transdiagnostic theory

Abbreviations

CDH – Chronic daily headache

Introduction

According to theoretical models of attention and emotion, threat captures and holds attention [1,2]. Within normative levels this is an adaptive response with survival value, allowing us to identify and respond to threats to our well-being [3]. Facilitated cognitive processing of mildly threatening stimuli becomes less adaptive however when such stimuli is irrelevant to current goals and serves as an emotional distracter, resulting in attentional interference and compromised performance [4]. An attentional bias refers to a selective attention towards specific information in one's environment, which is often experimentally explored in relation to threat. As such, an attentional bias can be defined as a predisposition towards threatening information relative to neutral or benign information [1,5]. Considering chronic pain, several theoretical models postulate its development can be precipitated by cognitive states such as hypervigilance or attentional bias towards threat [6-8]. Research provides evidence of an attentional bias towards pain-related information in patients with chronic pain, including musculoskeletal pain [9,10] and headache [11-14]. This has been supported by the results of two meta-analyses showing biases in chronic pain studies using the visual-probe task [15,16]. Overall, this research is supportive of Beck's [17] cognitive content-specificity hypothesis that processing biases are associated with information relevant to the individual's concerns only.

There has been interest in the similarities that may exist in the cognitive and behavioral processes that underlie different psychological disorders [18]. Emotion and pain are inexorably connected, and a transdiagnostic approach elucidating similar mechanisms underlying pain and mood disorders has been advocated [19]. Repetitive thinking on negative themes, including worry and rumination, is a common feature among anxiety and depressive disorders [20] and chronic pain [21]. Attentional biases for non pain-related threatening and negative information have been reported in anxious [1] and depressed [22] populations respectively and one line of investigation is whether biases for such information are also present in chronic pain. This is potentially important, as although participants with comorbid mood disorders/mental illness are often excluded from attentional bias research, anxiety and depression levels are typically still higher in those with chronic pain than healthy controls.

A number of controlled investigations show no evidence of heightened attentional bias for non pain-related threatening words ([23] social-threat words; [24] anger and social threat words) or images ([12] general-threat images; [25,26] angry facial expressions) in chronic pain patients relative to healthy controls. Few studies have used images of interpersonal threat in the visual-probe task specifically however, and the only study to use sad facial expressions did not compare chronic pain patients to healthy controls [27]. Further research is therefore needed. Painful facial expressions in naturalistic contexts contain a blend of different negative emotions. Pain research has provided evidence that, although the facial expression of pain is unique and distinct [28,29] from expressions of basic emotions (anger, disgust, fear, sadness, happiness and surprise)[30], it is better described as a fuzzy set than a prototype [31]. Multidimensional scaling of similarity judgments between pain and negative emotion prototype facial expressions has shown pain to fall close to sadness and anger, at the opposite end of the axis from fear, surprise and disgust [28].

Using the visual-probe task, the current experiment sought to establish whether individuals with chronic daily headache (CDH) display attentional bias towards interpersonal threat, i.e., angry and sad emotional facial expressions, and whether this bias differs to those shown by healthy controls. Happy expressions were also included, as former studies have reported mixed results with such stimuli. For example, Khatibi and colleagues [10] found chronic pain and healthy control participants to avoid happy expressions, while Liossi and colleagues [25] found all participants to maintain

gaze on happy expressions. The inclusion of happy emotional faces also allowed a test of two alternatives to the content specificity hypothesis: the valence hypothesis and the emotionality hypothesis [32]. The valence hypothesis in the context of chronic pain predicts that CDH individuals should show cognitive biases for both types of negatively valenced expression (angry and sad), but not for positive (happy) expression. The emotionality hypothesis, alternatively, predicts that CDH individuals should show cognitive biases for all types of emotional expression (angry, sad, and happy) relative to matched neutral expressions

Stimuli presentation times of 500 ms and 1250 ms were adopted to explore the time-course of bias. Biases at shorter presentation times are likely to reflect initial orienting and early attentional engagement, while longer exposure durations are likely to be more sensitive to processes involved in maintained attention [2]. Based on theoretical models of attention and emotion, it was predicted that all participants would show attentional biases towards angry and sad facial expressions, relative to neutral expressions. No differences were predicted between CDH and healthy control groups in attentional bias towards angry, sad and happy facial expressions presented for 500ms or 1250ms.

Method

Participants

A priori power analysis indicated greater than 90% power to detect differences of magnitude 0.5 between groups for a sample size of 46 [(effect size (large) = 0.50, Critical F(1, 44) = 4.06, Lambda = 11.50[33]]. Participants were recruited via press announcements from the University of Southampton, the wider Southampton community, and UK headache-focused charitable organizations. For the CDH group inclusion criteria were: (a) suffering from primary CDH and satisfying the criteria stated in the International Classification of Headache Disorders 2nd edition [34] i.e. occurring 15 or more days per month, for more than three months and in the absence of medication overuse, (b) aged 18 years or over, and (c) normal or corrected-to-normal vision. Exclusion criteria were: (a) having a diagnosis or receiving treatment for any psychiatric disorder, either currently or within the past five years, and (b) suffering from any other chronic pain including secondary chronic headaches. For the healthy control group inclusion criteria were: (a) aged 18 years or over, and (b) normal or corrected-to-normal vision. Exclusion criteria were: (a) having a diagnosis or receiving treatment for any psychiatric disorder, either currently or within the past five years, (b) suffering from any chronic pain (in terms of headache frequency having more than seven headaches per month), and (c) taking any psychotropic or analgesic medication regularly. Ten individuals were excluded from the investigation due to headache frequency (i.e. 8 – 14 days per month). All participants had good command of the English language.

Based on these criteria, 46 individuals (mean age = 31.36, SD = 13.44; range 18 to 62 years) participated, including 20 meeting the diagnostic criteria for CDH (mean age = 33.15, SD =15.03; range, 18 to 62 years) and 26 pain-free, healthy controls (mean age = 30.46; SD = 12.26; range, 18 to 55 years). The majority of participants were female (34; 74%). CDH participants reported living with chronic headache for a mean duration of 13.58 years (range 6 months to 45 years), with the majority (15; 75%) severely disabled by their condition, as indexed via their MIDAS scores. Fourteen (70%) CDH participants were suffering from chronic tension headache, and 6 (30%) from chronic migraine. All CDH participants were taking medication for their condition, with 9 (45%) reporting regular use of prescription medication (including sumatriptan, amitriptyline, gabapentin and zolmitriptan).

Questionnaires

The questionnaire battery was used to characterize the sample and assess cognitive and emotional aspects of participants' pain experience.

The Twenty-Item Toronto Alexithymia Scale (TAS-20; [35] is the most widely used measure of alexithymia, composed of 20 items organized in a stable and replicable three-factor structure congruent with the theoretical basis of alexithymia. Each item is rated on a 5-point scale. All items are included in a total sum score, and may be divided into difficulty describing emotions (DDE), difficulty identifying emotions (DIE), and externally-oriented thinking (EOT) subscales. Higher scores are indicative of increased alexithymia. The measure has good internal consistency (α = .82) [36] and good test-retest reliability (r = .74) [37].

The State-Trait Anxiety Inventory (STAI; [38] is a 40-item self report measure of state (i.e., how the respondent currently feels) and trait (i.e., how the respondent generally feels) anxiety. Items are rated on a 4-point scale, with possible scores ranging between 20 and 80 for both subscales. Higher scores represent more intense or more frequent feelings of anxiety. Barnes and colleagues [39] explored reliability generalization in 816 research articles employing the STAI between 1990 and 2000. Reliability coefficients showed an internal consistency of .91 and .89 for the state and trait scales respectively. Test-retest reliability was .70 and .88 respectively.

The Hospital Anxiety and Depression Scale (HADS) [40] is a 14 item measure of the severity of anxiety and depression symptoms experienced over the past week (seven items each). Items are rated on a 4-point scale, and possible scores for both subscales range from 0 to 21, with higher scores indicating a higher severity of symptoms. The HADS has been well validated, with a large scale investigation (n = 51, 936) revealing an internal consistency of .80 and .76 for anxiety and depressions subscales respectively [41].

The McGill Pain Questionnaire short-form (MPQ-SF) [42,43] consists of a 15-item adjective checklist designed to assess both affective and sensory aspects of pain, as well as two single-item measures of present pain intensity. The factorial validity of the sensory and affective components of the MPQ-SF has been empirically supported (internal consistency estimates for the sensory and affective dimensions .78 and .76 respectively [43]. Research has also supported the high reliability of the self-administered MPQ-SF (intra-class correlation coefficients: total = .96; sensory = .89, affective = .89, and average pain = .88) [44].

The Migraine Disability Assessment (MIDAS) Questionnaire [45] assesses headache-related disability. Individuals with headache answer five questions, scoring the number of days in the past 3 months they experienced activity limitations due to headache. The overall score is categorized to yield four grades of increasing disability. The MIDAS has been shown to be internally consistent, highly reliable, valid, and correlates with physicians' clinical judgment [45,46]. In line with current clinical practice and research the MIDAS was applied to all CDH participants regardless of headache type [47,48].

Experimental Stimuli

Four separate image-pair conditions were used, including angry/neutral, sad/neutral, happy/neutral, and neutral/neutral (filler) conditions. These stimuli were taken from the NimStim Face Stimulus Set [49] each featuring a full-color image of a single model against a white background. Images were resized to 280 pixels high x 218 pixels wide. All models wore a grey covering from the neck downwards, hiding their clothes. For each of the three emotional

image groups (i.e. angry, sad and happy), an emotional expression was paired with a neutral expression, featuring the same model in the same position. The emotional expressions corresponded with descriptions provided by Ekman and Friesen [50]. Six male and four female models were included in the angry/neutral and sad/neutral conditions, and five male and five female models in the happy/neutral and neutral/neutral conditions. Eight practice neutral/neutral images pairs were also included, taken from an online image database, and featured the same model against a white background. Four buffer neutral/neutral images pairs were included in the main task, which were taken from the NimStim Face Stimulus Set [49].

A preliminary analysis of the valence and arousal of the experimental stimuli was conducted with a computerized version of the Self-Assessment Manikin (SAM) [51]. Images were randomly presented to 10 independent participants (4 male, 6 female; mean age = 24.90; SD = 3.54), for 3 seconds each. Following this, two 9-point SAM scales were presented, one for valence and one for arousal. Participants were instructed to indicate how happy and aroused they felt while viewing each image, using the computer mouse to provide their responses. Angry images were rated as significantly more arousing (mean = 5.10 (0.74); $t(9) = 5.01$, $p = .001$) than their neutral (mean = 3.30, (0.68)) counterparts. Sad images were rated as significantly less pleasant (mean =3.40 (.52); $t(9)= -6.09$, $p < .001$) and more arousing (mean = 4.10(.74)), ($t(9)= 4.71$ $p= .001$) than their neutral counterparts (mean = 4.70(.48) and mean = 3.00 (.00) respectively). Happy images were rated as significantly more pleasant (mean = 6.50 (.53), $t(9) = 7.97$, $p < .001$) and arousing (mean = 4.30(.68); $t(9)= 9.00$, $p < .001$) than their neutral counterparts (mean = 4.80 (.42) and mean = 3.10 (.32) respectively). Comparing emotional images to each other, both angry ($t(9)= -13.29$ $p <. 001$) and sad ($t(9)= -17.27$, $p <.001$) images were significantly less pleasant than happy images.

Visual-Probe Task

The visual-probe task was developed in Presentation® (version 12.2; Neurobehavioral Sciences), and run on a PC with a 15-inch color monitor. A total of 320 experimental trials were included, along with 8 initial practice trials and 4 buffer trials (i.e., 2 buffer trials prior to each experimental block). Each trial began with the display of a central fixation cross for 500 ms. A randomly selected image-pair was then presented horizontally for either 500 or 1250 ms. The distance between the inner edges of each image was 5 cm. Immediately after the offset of the image pair, a probe appeared in either the left or right location. This remained until either the participant's response or 1500 ms had elapsed. Participants indicated the location of the probe as quickly and accurately as possible using a two-button response box. The two presentation times were applied in a randomized order over all trials. Each of the 30 emotional image pairs (i.e. 10 angry, sad, and happy images with their matched control images) was presented eight times; four times for 500 and 1250 ms each. Within each presentation time condition, each emotional image appeared twice in the left location and twice in the right location. The probe location was fully counterbalanced across each emotional image location. The 10 neutral/neutral control stimuli were also fully counterbalanced for image and probe location. All text, fixation crosses and probes were presented in white against a black background. The visual-probe task lasted approximately 20 minutes.

Procedure

Ethical approval was obtained from the Research Ethics Committee of the Academic Unit of Psychology, University of Southampton. All participants provided informed consent prior to their inclusion in the study, in compliance with regulations of the institution and the guidelines of the Helsinki Declaration. Participants first completed the visual-probe task, seated approximately 60 cm from the monitor. To avoid potential priming on the visual-probe task, participants completed the questionnaires last. To control for potential order effects, questionnaires were presented in a new random order to each participant.

Data Reduction and Analytic Plan

Response times from practice and buffer trials, along with incorrect responses, were removed from analysis. Following inspection with box-and-whisker plots, response times less than 200 ms and more than 1000 ms, and then more than 3 SDs above or below each participant's mean, were excluded as outliers. Attentional bias scores were calculated separately for each presentation time condition (500 and 1250 ms) and emotional expression condition (angry, sad, happy) using the following equation:

Attentional bias score= ((ElPr – ErPr) + (ErPl – ElPl))/2

Here E = emotional face, P = probe, l = left position, and r = right position. In this equation for example, ElPr corresponds to the mean latency when the emotional face is in the left position and the probe in the right position. Positive bias scores indicate a shift of attention toward the location of emotional expressions relative to neutral expressions. Negative bias scores indicate a shift of attention away from the location of emotional expressions towards neutral expressions. A bias score of 0 denotes equal attentional engagement of both emotional and neutral expressions.

Differences in demographic characteristics between groups were explored with χ^2 and t tests/Mann-Whitney U test for categorical and continuous variables respectively. A 2 × 2 × 2 analysis of variance (ANOVA) of attentional bias scores was carried out with group (CDH, control) as a between-subjects independent variable, and presentation time (500, 1250 ms) and image type (angry, sad, happy) as within-subject independent variables. Pearson's correlation coefficients were calculated between attentional bias scores at each presentation time with the questionnaire measures and headache frequency. For ANOVA analyses, alpha level was set at .05, two-tailed. Due to the high number of correlations calculated, alpha level was set at .01 for these analyses. All analyses in this investigation were conducted in SPSS 21.0 for Windows.

Results

Group Characteristics

The CDH and control groups did not differ significantly in sex ratio [CDH group: 16 (80%) female, Control group: 18 (69%) female, $\chi^2 = .68$, $p = .41$], or in age (age was found to be positively skewed upon histogram inspection, and therefore a Mann Whitney U test was performed on this variable) [CDH group: 33.15 (SD = 15.03), Control group: 30.46 (SD = 12.26), $U = 259.5$, $p = .99$]. Mean self-report data for both CDH and healthy groups are presented in Table 1. All questionnaires demonstrated good levels of internal consistency or higher (≥ .08) [52], apart from the external orientated thinking subscale of the TAS-20 which showed unacceptable consistency. A series of independent t-tests were conducted on measures administered to both groups. A Bonferroni correction for multiple comparisons was applied, with an adjusted alpha of .005 adopted. Based upon this, significantly higher levels of depression ($p < .001$) were reported by the CDH group compared to the healthy control group.

Visual-Probe Analysis

The groups did not differ significantly in the amount of data lost

Measure	Chronic daily headache group (*n* = 20)	Healthy group (*n* = 26)	Mean difference	*t*	*df*	*p*
HADS anxiety	9.65 (5.44)	6.62 (3.58)	3.04	2.16	31	.039
HADS depression	6.55 (3.83)	2.46 (2.39)	4.09	4.19	30	.001
STAI state	39.90 (14.23)	35.12 (7.39)	4.79	1.37	27	.182
STAI trait	44.05 (14.50)	37.62 (9.86)	6.44	1.79	44	.080
TAS-20 total	50.25 (13.36)	44.15 (13.37)	6.10	1.53	44	.132
TAS-20 DIE	19.35 (7.46)	14.65 (6.29)	4.70	2.32	44	.025
TAS-20 DDE	12.70 (5.28)	11.73 (5.26)	0.97	.62	44	.539
TAS -20 EOT	18.20 (3.79)	17.77 (4.58)	0.43	.34	44	.735
MPQ Sensory	16.55 (5.94)					
MPQ Affective	4.95 (3.22)					
MPQ Total	21.50 (8.45)					
MPQ Visual analogue scale	45.50 (31.33)					
MPQ Present pain intensity	3.30 (1.08)					

Table 1: Mean (SD) questionnaire scores for chronic daily headache and healthy control groups.
Note: HADS = Hospital Anxiety and Depression Scale; STAI = State Trait Anxiety Inventory; TAS-20 = Toronto Alexithymia Scale-twenty item version(DIE = difficulty identifying emotions subscale; DDE = difficulty describing emotions subscale; EOT = externally-oriented thinking subscale); MPQ = McGill Pain Questionnaire- short form.

Image category	Chronic daily headache group (*n* = 20)		Healthy group (*n* = 26)	
	500ms	1250ms	500ms	1250ms
Angry expressions	7.22 (15.23)	9.11 (21.47)	10.46 (24.55)	8.77 (22.91)
Sad expressions	3.36 (24.72)	5.23 (21.16)	15.77 (20.34)	8.63 (22.13)
Happy expressions	-0.91 (26.21)	4.26 (15.18)	-0.65 (18.25)	9.72 (24.48)

Table 2: Mean (SD) attentional bias indices across image condition and presentation times for chronic daily headache and healthy control groups.

due to errors (M = 1.11%, SD = 1.04), outliers (M = 1.47%, SD = .69), or in overall mean response time (M = 397.53ms, SD = 63.32). Means for the attentional bias indices are presented in Table 2. Depression scores were not included as a covariate in an ANCOVA as two assumptions of the ANCOVA statistic were violated: (i) no significant correlations were found between depression scores with any of the bias indices, and (ii) Levene's test for homogeneity revealed unequal variances between CDH and control groups (F = 9.35, p = .004)[53].

ANOVA revealed no significant main effect of group, $F(1, 44)= 3.14$, $p = .08$, $\eta p^2 = .07$, image type, $F(2, 88) = 1.48$, $p= .23$, $\eta p^2 =.03$, or presentation time, $F(1, 44) = .65$, $p= .42$, $\eta p^2 = .02$. No significant interactions were found for image type x group, $F(2, 88) = .42$, $p = .66$, $\eta p^2 = .01$, image type x presentation time, $F(2, 88) = 1.41$, $p = .25$, $\eta p^2 = .03$, or presentation time x group $F(1, 44) = .33$, $p= .57$, $\eta p^2 = .01$. Finally, no significant interaction was found for presentation time x image type x group, $F(2, 88) = .62$, $p= .54$, $\eta p^2 = .01$.

Comparisons to 0

Attentional bias indices were compared to 0. Considering groups separately, CDH participants showed a significant bias towards angry expressions at 500ms, $t(19) = 2.12$, $p = .05$. Healthy participants showed significant bias at 500ms towards angry expressions, $t(25) = 2.17$, $p = .04$, and sad expressions, $t(25) = 3.95$, $p < .001$, and at 1250ms towards happy expressions, $t(25) = 2.02$, $p = .05$. When data from the two groups were combined, significant biases towards angry expressions were found at both 500ms, $t(44) = 2.94$, $p = .01$ and 1250ms, $t(44) = 2.74$, $p = .01$, towards sad expressions at 500ms, $t(44) = 3.07$, $p < .01$, and 1250ms, $t(44) =2.25$, $p = .03$, and happy expressions at 1250ms, $t(44) = 2.38$, $p = .02$.

Correlation Analysis

Considering correlation results per group, examination of the CDH group at the 500ms presentation time revealed a positive correlation between state anxiety and the happy expression bias index, $r = .676$, $p = .001$. All participants were also included together in an overall correlational analysis; at the 500 ms presentation time, state anxiety was positively correlated with the happy expression bias index, $r = .404$, $p = .005$. No other significant correlations were found.

Discussion

The aim of this experiment was to investigate whether individuals with CDH show attentional bias towards interpersonal threat and happy expressions, and whether their patterns of bias differ to those shown by healthy individuals. Supporting the first hypothesis, data from both groups combined revealed significant biases towards angry and sad expressions at 500 ms and 1250 ms presentation times. No significant differences in attentional bias were found between CDH and healthy control groups, supporting the second hypothesis.

That all individuals regardless of pain status bias towards images of interpersonal threat is in agreement with the notion that such responses are normal and adaptive [2,3]. A lack of heightened bias in individuals with CDH specifically, however, is of theoretical importance for models of CDH development and maintenance. It could be argued that the transdiagnostic approach is especially relevant to understanding chronic pain in relation to anxiety and depressive disorders, given that they are often highly comorbid [54], share considerable joint genetic vulnerability [55], and can all respond to the same drugs. The present investigation emphasizes

the differences between these disorders in terms of information-processing biases, a finding that, apart from its theoretical significance, has direct implications for the psychological management of CDH in terms of choosing suitable targets for treatment. While anxious [1] and depressed [22] individuals, compared to healthy non-clinical individuals, show heightened attentional biases for threatening and negative information respectively, the same effects are not shown in individuals with chronic pain relative to healthy controls. Therefore, although common mechanisms of repetitive negative thinking, worry, and rumination may underlie biases across disorders, such mechanisms do not appear to result in specific biases for the same type of information. Overall, support is therefore provided for Beck's [17] cognitive-content specificity hypothesis across disorders. Evidence is not provided for either the valence or emotionality hypotheses specifically in CDH.

Comparisons to 0 showed that when data from the two groups were combined, significant biases towards angry and sad expressions were found at both 500ms and 1250ms, while biases towards happy expressions were found only at 1250ms. This suggests attention across presentation times prioritizes emotionally negative or threatening information. Negative stimuli are hypothesized to carry greater informational value than positive stimuli, and to thus require greater attention and cognitive processing [56]. The fact that there was also an overall attentional bias towards happy images at 1250ms lends support to theories of emotion, which propose that, although responses to affective pictures form two factors that vary with the level of valence and arousal of the picture, it is mostly the valence of a stimulus that determines its capacity to capture attention [57]. Indeed, in the current experiment, preliminary analysis revealed angry and sad expressions to both be significantly less pleasant than happy expressions. Follow up investigations could further explore this theory by varying the affective valence (either pleasant or unpleasant) of stimuli, testing whether stimuli with high valence are more likely to attract attentional processing than stimuli with mild affective valence.

State anxiety was significantly correlated with the happy bias index at 500 ms for the CDH group. A potential explanation is that as state anxiety increases, bias towards positive information is displayed in order to try and reduce anxiety. A distinction between automatic and deliberate mood regulation has been proposed [58], with the current study finding evidence for the former. Emotion regulation strategies may not have been engaged in deliberately (i.e. at 1250ms) however, as anticipation of the upcoming probe, and the necessary motor response, may have overridden any conscious tendencies to predominately monitor one of the stimuli pair.

The strength of the present study was the inclusion of a measure of alexithymia, which has been described as a difficulty in identifying, differentiating and communicating one's emotional states [59]. Additional characteristics include difficulties distinguishing different emotional states from one another, and also emotional states from somatic states [60]. High levels of alexithymia have been found in chronic pain populations [61], although little consideration of this variable has been given in former chronic pain research. As no significant differences were observed between CDH and healthy control groups in alexithymia, the pattern of results obtained cannot be attributable to differences in this variable.

Limitations of the present study should be noted. First, the small sample size only allowed for the detection of large effect sizes should they exist. Second, as all participants with CDH reported the use of regular pain medication, the possibility remains that such medication had an effect upon response times. However, overall mean response times did not differ significantly between CDH and healthy control groups. Third, it remains unknown whether CDH patients with comorbid anxiety or depressive disorders would demonstrate biases towards angry and sad faces respectively, although this is predicted based upon schema theory [62]. In conclusion, supporting theories of emotional processing the results from the present investigation and previous literature suggest that attentional biases towards interpersonal threat are not specifically heightened in individuals with CDH relative to healthy controls, but rather are demonstrated by all individuals regardless of pain status.

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Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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***Corresponding author:** Christina Liossi, Pain Research Laboratory, Academic Unit of Psychology, University of Southampton, Highfield, Southampton, SO17 1BJ, UK, Tel: 440-238-059-4645; E-mail: C.Liossi@soton.ac.uk

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