

The Influence of Positive and Negative Affect on Emotional Attention

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Abstract

Background and Objectives: Mechanisms of engagement and disengagement of attention to emotional information are thought to contribute to the onset and maintenance of anxiety and depression, a conclusion based largely on findings in analogue subclinical samples. However, we argue that traditionally defined analogue samples can be misleading. Firstly, research has challenged the adequacy of conventional measures of subclinical traits by illustrating that supposedly distinct scales are highly inter-correlated and do not therefore measure independent constructs. Secondly, recent research in clinical groups has revealed results opposite to those expected from the analogue literature, suggesting speeded, rather than impaired, disengagement from threat. **Methods:** We present analogue findings, from a sample of 70 healthy participants, allowing a purer distinction between the phenomenology of anxiety versus depression using the orthogonal traits of positive and negative affect to classify individuals. **Results:** Using emotional peripheral cueing we found that, at short cue durations, dysphoric individuals' (those with low positive and high negative affect) attention to facial expressions was slowed by emotional compared to neutral invalid cues. **Limitations:** Limitations included a small sample size and limited generalisability due to sampling from a student population. **Conclusions:** The data suggest that, in line with the previous subclinical literature, dysphoric individuals are slow to disengage attention from emotional information at early stages of processing and are consistent with the possibility that patterns of orienting of attention might be qualitatively different in subclinical versus clinical populations.

235 words.

Introduction

Emotional cuing reveals engagement and disengagement of selective attention. A substantive body of empirical work has demonstrated that emotional material, relative to neutral, is prioritised for attentional processing (Yiend, 2010; Vuilleumier, 2005). One paradigm used to examine these effects is the peripheral cueing task (Posner 1980) in which visual onsets (cues) are assumed to direct participants' attention towards the location in which they appear. Reaction times to detect targets subsequently appearing in cued (valid) or uncued (invalid) locations can be used to assess the relative attentional costs and benefits of different types of cue (e.g., those with positive and negative valence) and are taken to reflect the cognitive mechanisms of disengagement and engagement of selective attention, respectively (Fox, Russo, Bowles, & Dutton, 2001; Yiend & Mathews, 2001; Fox, Mathews, Calder & Yiend, 2007). Although this emotional version of the cuing methodology has been criticized (Clarke, MacLeod, & Guastella, 2013; Mogg, Holmes, Garner, & Bradley 2008), expert opinions remain mixed (Yiend, 2010) and there is widespread agreement that the emotional cuing task has played an important part in the advancement of our understanding of the attentional mechanisms associated with anxiety and depression.

Attentional biases in anxiety and depression. Mechanisms of engagement and disengagement of attention to emotional information, along with other cognitive biases, are thought to contribute to the onset and maintenance of psychological disorders. For instance, group differences in biased processing related to pathology tend to be present at low intensities of affective content and are especially evident where stimuli are disorder-relevant (Yiend, 2010). Anxious individuals, for example, show increased attentional orienting towards the location of anxiety-relevant versus neutral stimuli at short stimulus onset asynchronies (SOAs: Mathews, Fox, Yiend & Calder 2003; Yiend & Mathews 2001) and detect fear-related relative to happy faces more efficiently in an attentional blink paradigm (Fox, Russo, & Georgiou, 2005). In depression, increased attentional orienting towards the location of depression-relevant stimuli usually occurs at longer SOAs (eg. Donaldson, Lam & Mathews, 2007; Joorman & Gotlib 2007). One possible explanation for this

pattern in depression is that these individuals fail to inhibit depression-relevant information once it has been attended. Supporting this, depressed participants have been found to show impaired disengagement of attention from negatively valenced stimuli at longer stimulus presentations in both cueing and attentional blink paradigms (Koster, De Raedt, Goeleven, Franck & Crombez 2005; Leyman, De Raedt, Schacht & Koster 2007; Koster, De Raedt, Verschuere, Tibboel & DeJong 2009; Koster, De Raedt, Leyman & De Lissnyder 2010), while anxious participants show delayed disengagement from anxiety-relevant information at relatively short stimulus presentations (Fox et al, 2001; Yiend & Mathews, 2001).

Evidence suggests that biases in attention to emotional material are linked to traits predisposing people to depression and anxiety rather than the acute affective states themselves. For instance, in depression similar biases have been found in recovered depressed participants and also in never-depressed daughters of depressed mothers (Joorman & Gotlib 2007; Joorman, Talbot & Gotlib 2007). Most of the engagement and disengagement effects described above have used analogue samples of preselected individuals from the healthy population. Although not meeting criteria for a clinical disorder themselves, these individuals are assumed to perform like those who do. In the literature on anxiety and attention, in many cases this assumption has proven justified. For example, individuals with elevated trait anxiety show enhanced attentional biases toward threat following a similar pattern to that found in Generalized Anxiety Disorder (GAD) patients, on emotional Stroop and attentional probe tasks (Yiend, 2010).

Recent work on engagement and disengagement effects using the emotional cuing paradigm described above has, however, raised the possibility that the continuity between analogue and clinically anxious samples may not be ubiquitous. In work reported by Yiend and colleagues (2015), two separate studies investigated individuals diagnosed with GAD, healthy volunteers, and individuals with high trait anxiety (but not meeting GAD diagnostic criteria). While previous research using cuing methods in studies with high trait anxious participants suggested that negative

attentional bias is due to slowed disengagement of attention from negative information (e.g., Fox et al, 2001), Yiend et al. (2015) found *faster* disengagement from negative (angry and fearful) faces in the clinically anxious (GAD) group, suggesting that once a clinical disorder has developed, the pattern of attentional orienting might actually reverse; the attentional ‘hold’ of threat seen in high trait samples, may become an attentional ‘avoidance’ effect with the onset of GAD.

The inadequacy of traditional trait anxiety and depression measures. Discontinuities of this sort between subclinical samples and their corresponding clinical diagnoses highlight a potential difficulty with the use of subclinical trait measures as analogue markers of psychopathology. One possible confound is that some of the instruments commonly used to measure trait anxiety and trait depression do not adequately distinguish these conditions. Thus, while anxiety and depression are phenomenologically distinct (anxiety reflecting agitation, worry and dread but depression reflecting gloom, apathy and hopelessness), measures of trait anxiety and depression are frequently highly correlated (coefficients in the range .45-.75 according to Clark and Watson, 1991) and item content can overlap. Such difficulties have led to alternative conceptualisations of anxiety and depression, with the aim of improving their discriminant validity (e.g., Watson, Clark & Tellegen, 1988). This approach might allow for a better understanding of the unique patterns of cognitive biases associated with anxiety and depression.

The positive and negative trait affect alternative. To illustrate, Watson and colleagues (e.g., Watson, Clark & Carey, 1988) argue that subjective emotional experience falls into two broad categories: positive (PA) and negative affect (NA: Watson, Clark & Tellegen 1988). An individual with high trait PA will have a general tendency to experience a greater intensity and frequency of positive mood states, whilst an individual with high trait NA will experience a greater intensity and frequency of negative mood states. Depression and anxiety are highly correlated with trait NA, both concurrently and prospectively, whilst only depression is systematically related to PA (Watson & Clark 1995). Watson and Clark’s tripartite model proposes that while depression and anxiety are

both characterised by high negative affect, only depressed individuals experience low levels of positive affect (Clark & Watson 1991a). This approach suggests that using self-reported scales of positive and negative affective traits can therefore provide a more valid way to investigate the phenomenology of anxiety versus depression.

As discussed by others (e.g. Koster et al. 2005), there are strong arguments for exploring how trait PA and NA relate to attentional biases, rather than focusing on traditionally defined concepts of anxiety and depression. Firstly, self-report measures of anxiety and depression are typically highly correlated creating difficulties in independently investigating these constructs (Clark & Watson 1991b, Koster et al. 2005, Koster et al. 2009, Koster et al. 2010). In contrast, the constructs of PA and NA are orthogonal and can therefore be investigated independently of each other (Watson et al. 1988). Secondly, evaluating trait PA and NA encourages the exploration of a wider area of emotional space and can potentially generate results more readily applicable across both the general population and the extremes of psychopathology. Finally, this approach is also in line with the increasingly popular focus on functional mechanisms and transdiagnostic processes as an important way to understand a wide variety of psychopathologies (Harvey, 2008; Yiend, Savulich, Coughtrey & Shafran, 2011).

Covert or overt attention? The emotional attentional cueing task has generally been assumed by previous studies to measure covert, as opposed to overt, attention, since participants are instructed to fixate the central cross throughout each trial, without moving their eyes. However this assumption can only be justified if eye movements are measured during each trial, to confirm that central fixation is indeed maintained. Many studies omit this methodological check for practical reasons, such as the need for specialist equipment and the additional burden on participants. The distinction between covert and over attention is especially important in the context of psychopathology, since it clarifies which mechanisms are maladaptive: the internal, covert, process of assigning attentional priority, and/or the physical manifestation of attentional selection, namely

moving the eyes to a salient stimulus. Here, we used a compromise solution to check the assumption of eye fixation, by measuring eye movements in a subset of our sample.

In summary, the present research aimed to investigate how positive and negative trait affect influences covert attentional orienting to emotional facial expressions, using an emotional cueing paradigm with emotional and neutral faces. Single peripheral cues were used to investigate the allocation of spatial attention at short and long cue durations across a range of emotions in order to evaluate both early and late stages of information processing. We hypothesised that dysphoric individuals, defined as those with low PA and high NA, would show emotion specific biases at longer cue durations, indicating reduced inhibition of emotionally valenced stimuli. We chose this categorical approach in preference to a dimensional design in order to most closely map the present data onto the previous subclinical literature, which has almost exclusively compared discrete groups selected to differ in trait anxiety/depression level¹. We wished to examine whether those findings would replicate in our trait affect defined groups, or alternatively, whether results would now align more closely to the opposite findings recently reported in clinical (GAD) samples (e.g. Yiend et al 2015).

1. Method

2.1 Design

An emotional cueing paradigm was used to evaluate spatial attentional orienting to facial expressions of emotion in a sample of seventy undergraduate and postgraduate students. Effects were compared across four groups of participants selected according to trait PANAS scores relative to normative means from a large UK non-clinical sample (Crawford & Henry, 2004, n=1003). The four groups were denoted ‘high affect’ (high positive and negative trait affect); ‘dysphoric’ (high

¹ Furthermore, the multi-factorial design of the experiment meant that regression analysis was not feasible as the main analytical strategy. However, subsets of the data could be examined post-hoc to test their validity across the whole sample.

negative and low positive trait affect), ‘euphoric’ (high positive and low negative trait affect) and ‘low affect’² (low positive and low negative trait affect). The factorial experimental design was devised to contrast the effects of Trial Type (valid, invalid), Emotion (emotional, neutral) and Cue Duration (Short: $\leq 100\text{ms}$, Long: $\geq 500\text{ms}$) on spatial orienting across the four groups, using target response time as the dependent variable. The categorisation of cue duration was designed to capture early automatic and later strategic processes.

2.2 Participants

Seventy participants from Oxford University were screened and selected into one of the four groups based on their scores on the trait version of Positive and Negative Affect Schedule (PANAS; Watson et al. 1988). Participants were asked to rate to what extent they generally experienced each of 10 positive emotions (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active) and 10 negative emotions (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid) on a scale from 1 (“very slightly or not at all”) to 5 (“extremely”). Possible scores on each subscale range from 10 to 50. The PANAS subscales are stable over a 2 month period, are highly internally consistent, and orthogonal (Watson et al. 1988).

Those with both PA and NA scores above the normative mean for that subscale (normative means: 31 and 16, respectively, Crawford & Henry, 2004) comprised the ‘high affect’ group ($n=19$). Those with PA below and NA above the normative mean were designated the ‘dysphoric’ group ($n=20$). The ‘euphoric’ group had PA above and NA below the normative mean ($n=20$). Finally, those with both PA and NA below the normative mean were classed as the ‘low affect’ group ($n=11$).

2.3 Materials

² Participant numbers in the low affect group were too low ($n=11$) for meaningful interpretation and therefore are presented for completeness only and not interpreted or discussed.

2.3.1 Stimuli. Facial expression stimuli used as cues were taken from the Ekman series (Ekman & Friesen 1976), and the JACFEE and JACNeuF sets (Matsumoto & Ekman 1988). Emotional cues comprised equal numbers of faces expressing the emotions of happiness, sadness and fear, while neutral cues were facial expressions showing no emotion. Twenty different identities were selected based on expression recognition norms provided with the stimuli sets. The stimuli were monochrome photographs of men and women looking straight ahead and were cropped to exclude hair and other non-facial distracters. Six practice cues were made using other identities.

2.3.2 Attentional Task. The attentional cuing task comprises valid and invalid trials and was used in a standard factorial design to contrast responses to emotional and neutral cues presented at either short to long cue durations. Stimuli were organised into three blocks of 240 trials per block, 720 trials in total. The factor Emotion comprised three types of emotional cue: sad, happy, and fearful and one type of non-emotional cue: neutral. The factor Cue Duration comprised 2 levels, short (50 or 100ms) and long (500 or 1000ms). There is no clear consensus about what durations of cue exposure best capture early automatic and longer strategic processes in selective attention. We therefore sampled two different durations (in equal proportion) at each level, in order to best reflect the typical durations found in the previous literature. The factor Trial Type was operationalized using a predictive cuing ratio of 2:1, valid: invalid trials, such that cues indicated a 60% likelihood of the target occurring in the cued location. Valid trials were those where the location of the target was the same as the preceding cue; invalid trials were those in which the cue and target appeared in opposite locations. All factors were combined using a fully crossed factorial design within blocks. For example, within each block 80 trials (1/3) were invalid and 160 (2/3) were valid (in total 240 invalid and 480 valid trials) and levels of Emotion and Cue Duration were nested within each type of trial. Where a task has a multi-level within participants' factor structure, as here, it is important to ensure that the number of observations per cell provides adequate sampling of the variance in

participants' responses to each condition within the task design. In this experiment there were a minimum of 30 observations per condition overall within our analytical design (e.g. 30 invalid, or 60 valid, trials per emotion per cue duration). The task was delivered using E prime software version 1.1 and trial conditions were presented in a fully randomised order.

2.4 Procedure

The study was approved by the local University of Oxford research ethics committee and participants gave written informed consent. They were seated 100 cm from the screen to ensure a consistent viewing angle³. Instructions were presented on the computer screen, followed by 18 practice trials and 720 trials in total. Individual trials started with a central fixation cross presented for 1000ms, followed by a neutral, sad, happy or fearful face for 50, 100, 500 or 1000ms, which appeared on either the left or the right of the screen. The face cue was then removed from the screen, replaced by a target letter, either an 'E' or an 'F', and presented either at the same location as the cue (valid trials), or at the opposite location (invalid trials). The target remained on the screen until response or for 5000ms, whichever occurred first. On practice trials, but not experimental trials, automated feedback (an auditory tone and visual display: 'Incorrect Response') was used to alert participants to errors. The visual angle between cue and target was 6° and targets subtended 0.37° of visual angle. Instructions asked participants to keep their gaze fixed on the central cross throughout each trial. They were told that a face would appear briefly followed by a

³ The visual angle between the centre of each stimulus in the pair and the central fixation cross is a crucial parameter in attentional bias studies and it is this which determines the correct viewing distance, according to the equation:

$$\lambda = h / d ,$$

where λ = visual angle in degrees; h = 'on screen' distance in cm; d = distance from stimulus to eye in cm.

and allows good comparability across different studies. The standard visual angle in methodologically tight attentional bias studies is around 6 degrees. Full methodological details can be found in Yiend, J., & Mathews, A. (2004).

letter and that their task was to identify the letter as quickly but as accurately as possible by pressing the corresponding button (upper for F; lower for E) on a serial response box.

For a randomly selected subsample of 15 participants (21% of the sample), eye movement monitoring headgear was fitted and calibrated prior to starting the task. Horizontal eye-movements from the right eye were monitored throughout the experimental task using the IRIS eye movement measurement system, (SKALAR, Cambridge Research Systems).

After the attentional task all participants completed the following questionnaires: the Beck Depression Inventory (BDI; Beck, Steer & Brown 1996); the trait version of the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger 1983) and, where more than two months had elapsed since recruitment, the trait version of the PANAS (Watson et al. 1988). Each session lasted approximately one hour.

2. Results

3.1 Sample characteristics

The sample of 70 consisted of 26 male and 44 female students, aged 18 to 30. The mean score on the Positive Affect subscale of the PANAS was 31, and on the Negative Affect subscale 19.

Descriptive data for each group is summarised in Table 1. As shown, groups differed significantly in PA and NA, in the expected directions according to group assignment.

Table 1. Participant Characteristics

<i>Group 1</i> <i>(High Affect)</i>	<i>Group 2</i> <i>(Dysphoric)</i>	<i>Group 3</i> <i>(Euphoric)</i>	<i>Group 4</i> <i>(Low Affect)</i>	<i>p</i>
High NA		Low NA		

	High PA	Low PA	High PA	Low PA	
N	19	20	20	11	
Gender: males/females	7/12	7/13	9/11	3/8	ns
Age (years) mean (sd)	20 (1.1)	21 (2.4)	21 (2.5)	21 (1.3)	ns
PANAS- Positive Affect mean (sd)	34 (3.3) ^b	25 (3.9) ^a	36 (3.2) ^b	27 (3.7) ^a	<.0001
PANAS- Negative Affect mean (sd)	24 (6.5) ^b	23 (5.5) ^b	13 (2.1) ^a	15 (3.1) ^a	<.0001
STAI -Trait mean(sd)	49 (10) ^c	49 (7.1) ^c	33 (6.0) ^a	42 (4.9) ^b	<.0001
BDI mean (sd)	9.2 (6.9) ^a	11 (8.0) ^b	4.1 (3.6) ^a	8.1 (4.1) ^a	<.006

^{a,b,c} means with the same superscript do not differ significantly

NA= negative affect; PA = positive affect; PANAS = Positive and negative affect schedule; STAI = Spielberger State-Trait Anxiety Inventory; BDI= Beck Depression Inventory

3.2 Attentional Effects

Participants made errors on 252 trials (1.5% of the total number of trials). These trials were removed from the dataset. Reaction times less than 100ms (1.3% of correct trials) or greater than 2 standard deviations above the mean (2.4% of correct trials), were considered outliers and removed. Once error trials and outliers had been removed, reaction times over the whole sample formed an approximately normal distribution, with a mean reaction time of 564.5ms (sd = 95.8 ms). Eye movement data showed that the subset of participants sampled were successful in keeping their eyes centrally fixated on 86% of trials in total.

A mixed model ANOVA of design Group (high affect, dysphoric, euphoric, low affect) x Cue Duration (short, long) x Trial Type (valid, invalid) x Emotion (emotional, neutral) was conducted on mean reaction times to detect the target⁴.

There were significant main effects of Cue Duration, $F(1, 66) = 16, p < 0.01$, partial $\eta^2 = 0.20$; Trial Type, $F(1, 66) = 14, p < 0.01$, partial $\eta^2 = 0.18$; and Emotion, $F(1, 66) = 4.6, p < 0.05$, partial $\eta^2 = 0.07$. Main effects were qualified by the significant interaction of Cue Duration x Trial Type x Emotion x Group, $F(3, 66) = 2.8, p < 0.05$, partial $\eta^2 = 0.11$. To interpret this further within-group ANOVAs of design Cue Duration (short, long) x Trial Type (valid, invalid) x Emotion (emotional, neutral) were conducted separately for each group. For those groups in which this three-way interaction remained, further follow up analyses were conducted until the specific nature of the effect was interpretable. Condition means for the interaction are shown in Table 2.

Table 2. Mean reaction times in ms on the attentional task. Standard deviation in parentheses.

	Valid Trials		Invalid Trials		
	Cue duration	Emotional cue	Neutral cue	Emotional cue	Neutral cue
Group 1 (High Affect, n=19)					
	Short (50/100ms)	571.5 (78.5)	578.3 (85.9)	558.8 (88.5)	558.9 (87.2)
	Long (500/1000 ms)	557.2 (71.9)	554.7 (72.4)	548.9 (75.0)	544.5 (74.5)
Group 2 (Dysphoric, n=20)					

⁴ Running the same analyses but specifying separate levels for individual emotional categories (fear, happy, sad) revealed that the effects reported were not qualified by the specific type of emotion.

Short (50/100ms)	554.4 (57.7)	556.4 (64.4)	542.3 (59.0)	528.4 (58.6)
Long (500/1000 ms)	544.6 (55.0)	538.7 (60.4)	539.9 (58.6)	539.3 (55.9)
Group 3 (Euphoric, n=20)				
Short (50/100ms)	562.8 (57.7)	555.5 (52.8)	537.6 (62.1)	536.6 (60.4)
Long (500/1000 ms)	552.9 (58.6)	546.0 (59.0)	528.5 (59.0)	530.0 (57.7)
Group 4 (Low Affect, n=11)				
Short (50/100ms)	576.3 (83.2)	566.8 (80.9)	566.9 (91.5)	577.8 (99.2)
Long (500/1000 ms)	566.8 (83.9)	550.6 (79.6)	565.2 (103.8)	556.5 (99.5)

Group One ('high affect': high PA and NA). There was one significant main effect, Cue Duration ($F(1,18) = 8.9, p < 0.005$, partial $\eta^2 = 0.33$), reflecting slowing at short (mean = 567 ms, S.E. = 19.1) compared to long durations, (mean = 551 ms, S.E. = 16.1ms). All other effects and interactions were non-significant.

Group Two ('dysphoric': high NA, low PA). There was one significant main effect of Trial Type ($F(1,19) = 7.3, p < 0.05$, partial $\eta^2 = 0.27$), qualified by a significant interaction of Emotion x Cue Duration x Trial Type, $F(1,19) = 6.5, p < 0.05$, partial $\eta^2 = 0.23$. Examining each cue duration separately revealed no significant effects at long Cue Durations (all F s < 0.8), but a significant Emotion x Trial Type interaction, ($F(1, 19) = 6.9, p < 0.05$, partial $\eta^2 = 0.23$) at short Cue Durations. Pairwise comparisons (for short cue duration data) revealed that on invalid trials, reaction times were significantly slowed on emotional (mean = 542.3 ms, S.E. = 13.2ms) compared to neutral (mean = 528.4ms, S.E. = 13.1 ms) trials, $t(19) = 2.2, p < 0.05$. On valid trials, reaction times to emotional (mean = 554.4ms, S.E. = 12.9ms) and neutral (mean = 556.4ms, S.E. = 14.4ms)

cues did not differ significantly. Thus, the overall pattern of results in Group 2 reflected significant slowing by emotional cues on invalid trials at early, but not later, stages of processing. Figure 1 shows the pattern of the data using index scores (reaction time to emotional cue minus neutral cue) to illustrate the degree of slowing across the different conditions for this group.

INSERT FIGURE 1 ABOUT HERE

Group Three ('euphoric': high PA and low NA). For Group 3 the follow up Cue Duration (short, long) x Trial Type (valid, invalid) x Emotion (emotional, neutral) repeated measures ANOVA revealed a significant main effect of Trial Type, ($F(1,19) = 46.9, p < 0.001$, partial $\eta^2 = 0.71$), with reaction times slower on valid (554.3ms, S.E. = 12.3 ms) than invalid (mean = 533.1ms, S.E. = 12.7ms) trials. No other effects were significant.

Group Four ('low affect': low PA and NA). As noted previously the sample size for this group was too low for meaningful analysis.

Regression analysis. We conducted a regression analysis to examine the relationship between dysphoria and attentional disengagement from emotional faces, in order to selectively test the significant findings for Group 2 (dysphoric) across the whole sample. The dependent measure was an emotional bias index calculated by subtracting neutral cued trials from emotional cued trials, meaning that a larger index reflected greater slowing by emotional relative to neutral cues. We ran a linear regression on invalid trials presented at short cue durations, entering the individual difference variables as predictors (PA, NA, BDI and STAI). The model was significant, $F(4, 69) = 2.78, p = .034$, with the combined effect of predictors accounting for just under 15% of the variance in attentional disengagement from emotion ($R = .382$; $R^2 = 0.146$; adjusted $R^2 = .094$). Further

details of the model are shown in Table 3 and reveal that negative affect and depression were both independently significant predictors of early disengagement.

Table 3. Linear regression model showing predictors of attentional disengagement from emotion at short (< 100ms) cue durations

Predictor	β	t	p	Partial correlation
PA	-.22	-1.72	0.09	-0.21
NA	.44	2.27	0.03	0.27
BDI	-.38	-2.40	0.02	-0.29
STAI-trait	-.22	-.97	0.34	-0.12

β = standardized Beta coefficient; NA= negative affect; PA = positive affect; BDI= Beck Depression Inventory; STAI-trait = Spielberger State-Trait Anxiety Inventory, trait version. Bold denotes independently significant predictor.

3. Discussion

Our study revealed significantly different patterns of attentional orienting to emotional information associated with different combinations of PA and NA levels. One group in particular revealed distinct orienting patterns, the dysphoric group (those with high NA but low PA). At early stages of processing (≤ 100 ms), dysphoria was associated with impaired disengaging of attention from emotional faces. Specifically, dysphoric participants were slower on emotional than neutral invalid trials at short cue durations, an effect which was not apparent on valid trials or at later stages of processing. Regression analysis on a subset of the experimental data but using the entire sample suggested a similar pattern in which the higher an individual's level of negative affect, the

slower they were to disengage from early emotional cues. Eye movement data confirmed that the subset of participants sampled generally kept their eyes centrally fixated. Assuming this was representative of the entire sample, it suggested that the effects found were primarily the result of covert as opposed to overt attention, as is often assumed, but rarely evidenced, by studies using this paradigm.

The data suggest that, in line with the previous subclinical literature, dysphoric individuals are slow to disengage attention from emotional information at early stages of processing. The data are consistent with the speculation that patterns of orienting of attention might be qualitatively different in subclinical versus clinical populations. We chose this categorical approach in preference to a dimensional design in order to most closely map the present data onto the previous subclinical literature, which has almost exclusively compared discrete groups selected to differ in trait anxiety/depression level. We wished to examine whether those findings would replicate in our trait affect defined groups, or alternatively, whether results would now align more closely to the opposite findings recently reported in clinical (GAD) samples (e.g. Yiend et al 2015).

Fit with hypothesis and existing literature. The pattern of delayed disengagement from emotional material in our dysphoric group could be considered consistent with a range of other findings in the literature. For example, depressed patients showed reduced inhibition of return relative to controls in an emotional cueing paradigm with angry faces (Leyman et al. 2007) and three studies have found that dysphoric students (defined according to self report low mood, as opposed to trait affect levels) show reduced inhibition of negative words (Koster et al. 2005, Leyman et al. 2007, Koster et al. 2010). Furthermore attentional blink paradigms using word stimuli have generated similar results (Koster et al. 2009). Several experts have concluded that attentional bias is only observed in depression when stimulus presentation duration is long (typically over 1000ms; e.g. Mogg & Bradley, 2005; Mathews & MacLeod, 2005). However, in a more recent meta-analysis investigating the magnitude of attentional bias in depression, Peckham

and colleagues (Peckham, McHugh & Otto, 2010) found no moderating effect of stimulus duration. They found very similar effect sizes for studies using 500ms and those using 1000ms or more and concluded that there was no empirical support for the hypothesis that the bias is optimally found at longer stimulus durations. Our findings accord with this view.

Anomalous findings. In contrast, the effects reported here were unlike some previous results in that they applied irrespective of the category of emotional information. It is possible that this was due to insufficient power within the present design to detect emotion specific effects. However, this is an unlikely explanation because the task design was powered on previous similar tasks in which individual differences between types of emotional stimuli have been detected (e.g. Yiend et al. 2015; Yiend & Mathews, 2001). Specifically, we allowed for a minimum of 30 observations per cell (60 on valid trials) with factors Emotion, Cue Duration and Trial Type included. An alternative explanation is that a more general bias towards emotion-relevant information operates at early stages of processing in dysphoria, only differentiating between specific types of emotion at later stages. Indeed, with respect to dysphoria, the specific mood congruent pattern found in previous emotional cueing studies has usually been at much later stages of processing ranging from 1000ms (Donaldson et al. 2007, Joorman & Gotlib 2007) to 1550ms (Koster et al. 2010). Thus it is possible that early, non-specific emotion processing is followed by more selective processing at later stages. It is perhaps only at this later point that positive information is ignored or suppressed and negative information selectively attended. It is important to acknowledge however that some findings remain inconsistent with this suggested pattern. For example Gotlib and colleagues (2005) reported dysphoria associated with increased inhibition of negatively valenced words and Koster and colleagues (2009) found emotional specificity in dysphoria at short durations. Indeed the recent meta-analysis by Peckham et al. (2010) suggests that differences in orienting across durations in depression do not constitute a significant, reliable pattern. Difficulties in reconciling the different findings include the wide differences in methodology and sample selection, as well as precisely

how to define what constitutes ‘late’ versus ‘early’ stages of processing and only further research will be able to resolve this.

Evaluating the trait affect approach. This is the first study to our knowledge to systematically investigate attentional orienting to emotion in groups differing in the orthogonal traits of positive and negative trait affect. The identification of a dysphoric group in our study based on the PANAS scales - rather than more traditional, but confounded, self-report measures of depression - is a key strength of the present investigation. In their Tripartite model, Watson et al. (1995) defined the lack of PA in depression as being the key distinguishing feature from anxiety and our dysphoric group was defined accordingly. Consistent with this, the dysphoric group was the only one to score significantly higher than the other groups on the traditional measure of depression, while not showing a corresponding pattern of differences on the traditional anxiety measure. This characterisation allows greater confidence in the validity of our findings of early slowed disengagement from emotion associated with dysphoria. While our data can only be preliminary and require replication, these findings suggest that an approach focussing on mutually exclusive orthogonal dimensions to differentiate individual differences could be a useful and valid means for investigating patterns of selective spatial attention, to identify the unique profiles associated with anxiety and depression.

Wider implications of findings. Our findings suggest that early attentional processes could contribute to maintaining an individuals’ affective state, not only in the case of pathology (as has been argued previously) but also across a wider spectrum of general population level individual differences. If this working hypothesis is correct, it has important implications for our understanding of the role of attention to emotion not only in psychopathology, but also in health. In dysphoric individuals, for example, their affective state may be enhanced and maintained by

increased exposure to and processing of emotionally salient material, as a result of slow attentional disengagement.

One question, recently raised in the literature, is whether there is a discontinuity between analogue and clinically anxious samples in their pattern of disengagement of attention. As noted earlier, most research into attention to emotion using analogue samples has suggested that negative attentional bias is due to slowed disengagement of attention from emotional information (e.g. Yiend, 2010), leading to the assumption that this pattern also characterises clinical anxiety. However, Yiend and colleagues (2015) noted that few, if any, previous studies have actually tested this assumption empirically. They then reported faster disengagement in their clinically anxious (GAD) group, while finding the expected impairments in a subclinical group. They suggested that once a clinical disorder has developed, the pattern of attentional disengagement might actually reverse. Here we wished to examine whether those subclinical findings would replicate in our trait affect defined groups, or alternatively, whether results would now align more closely to the opposite findings reported in clinical (GAD) samples (Yiend et al 2015). It is clear that the present data replicate previous analogue findings, despite the ‘purer’ sample characteristics. An important next step will be to replicate the proposed pattern including a broader, subclinical and clinical, sample and using measures of positive and negative affect alongside traditional scales to contribute to the validity of the constructs being investigated.

Limitations. Our study had several limitations including the small sample size, which decreased statistical power and rendered one of our groups (low affect) unavailable for meaningful analysis. Nevertheless the presence of an overarching four-way interaction is decisive in confirming that group differences were present, and these could be clearly interpreted in the case of the other 3 groups. The multi-factorial design of our experiment was not well suited to an analytical approach using regression, despite the dimensionality of some of the constructs we were

examining. Although we addressed this post-hoc using a ‘hypothesis-driven’ regression on a subset of our data, it would be informative to conduct further experiments specifically designed to permit more complex dimensional modelling. Additionally, findings from a student sample are limited in their generalisability. There are also interpretative limitations; a confound sometimes raised when interpreting emotional cueing paradigms is the presence of a general slowing effect on emotional trials (Mogg Holmes, Garner, & Bradley 2008). Indeed there was such a non-spatial general slowing effect in this study, with participants on average 2ms slower on emotional than neutral trials. However, in line with the suggested solutions outlined by Yiend (2010) we found that correcting for this in spatial attentional analyses did not change the pattern or significance of our findings.

Conclusions. The present work illustrates how the study of individual differences in PA and NA can enhance our understanding of selective attention to emotion. By using orthogonal personality constructs, as opposed to more popular but confounded dimensions such as trait depression and anxiety, it is possible to draw less ambiguous conclusions and ones which are potentially relevant not only to those with increased vulnerability to emotional disorders, but also to the wider spectrum of individual differences within the general population. In sum, the present research demonstrated dysphoric individuals had impaired disengagement from emotional faces at early stages of processing. There was no evidence of emotional specificity, suggesting early effects of emotion on attention may be relatively generic with regard to content. Overall these data suggest that early attentional processes may contribute to maintaining an individuals’ affective state by enhancing the processing of emotionally salient material in dysphoria.

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