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ATTENTIONAL BIASES FOR NEGATIVE INFORMATION IN INDUCED AND NATURALLY OCCURRING DYSPHORIA

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Summary—Two studies investigated the relationship between attentional biases for negative information and dysphoria—both induced (Study 1) and naturally occurring (Study 2). In a modified dot probe task a series of word pairs was presented, and *S*s responded to probes that replaced one of the words in each pair. The stimuli included depression-related, anxiety-related and neutral words. To examine the time course of the attentional biases, there were three exposure durations of the word pairs: 14 ms (+186 ms mask); 500 ms and 1000 ms. In Study 1, the depressed mood induction procedure was associated with greater vigilance for depression-related words at 500 ms, with a similar trend at 1000 ms. In Study 2, measures of depressed mood and vulnerability correlated positively with vigilance for negative words in the 1000 ms condition. There was no evidence from either study that depressed mood was associated with a pre-conscious bias for negative words (i.e. in the 14 ms masked exposure condition). However, this pre-conscious bias was associated with high trait anxiety in Study 2, consistent with previous research. The results are discussed in relation to theoretical and empirical work on cognitive biases in clinical and non-clinical anxiety and depression. © 1997 Elsevier Science Ltd

INTRODUCTION

A current controversy in cognitive theories of emotions concerns the existence of attentional biases in depression. Cognitive models based on schemas (Beck, 1976) or associative networks in memory (Bower, 1981) predicted biases in both anxiety and depression, in all aspects of information processing, including perception, attention, memory, and reasoning. Indeed, early studies indicated the presence of attentional biases for threat information in clinical and non-clinical anxiety (e.g. MacLeod, Mathews & Tata, 1986; Broadbent & Broadbent, 1988). However, there were failures to find corresponding attentional biases in depression (e.g. MacLeod *et al.*, 1986; Hill & Dutton, 1989). Such results led Williams, Watts, MacLeod and Mathews (1988) to propose an alternative model based on Mandler's distinction between integration (or activation) and elaboration. Briefly, they proposed that the locus of the anxiety-congruent biases is in automatic activation processes, operating at an early stage of processing, prior to awareness, which would be evident on selective attention and priming tasks. On the other hand, the locus of depression-congruent biases is in strategic elaboration, and therefore would be found on recall tasks, rather than on selective attention tasks.

Two tasks that have been widely used to investigate biases in pre-conscious processes and in selective attention are the dot probe and the modified Stroop colour-naming tasks.† In the latter, words are presented in different colours, *S*s being required to name the colour but ignore the word content. Individuals with generalised anxiety disorder (GAD) show greater interference in colour-naming threat, than neutral, words, compared with controls, which has been taken as

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†Other tasks have been used to investigate preconscious and attentional biases in depression and anxiety: e.g. dichotic listening (e.g. McCabe & Gotlib, 1993; Mathews & MacLeod, 1986), colour perception (e.g. Gotlib, McLachlan & Katz, 1988; Mogg, Mathews, May, Grove, Eysenck & Weinman, 1991). The former task was criticised by Holender (1986) because the interpretation of results is uncertain, e.g. reflecting preconscious or attentional switching effects. The latter has yielded mixed results, e.g., Gotlib *et al.* found a positive bias in non-dysphoric individuals but it was unclear whether this was due to absence of anxious or depressed mood. For the sake of brevity, these will not be discussed in detail here.

evidence of a bias in selective processing of threat (e.g. Mathews & MacLeod, 1985; Mogg, Mathews & Weinman, 1989). The dot probe task provides a more direct measure of shifts in selective attention towards the spatial location of emotional stimuli. Typically, in this task, pairs of words are presented (e.g. for 500 or 1000 ms), followed by a dot probe in the location of one of the preceding words. GAD patients were faster to detect probes which appeared in the same location as threat rather than neutral words, consistent with an attentional bias to threat (MacLeod *et al.*, 1986; Mogg, Mathews & Eysenck, 1992). Moreover, anxious individuals show a processing bias for threat stimuli even when their awareness of the stimuli is restricted by the use of brief (e.g. 14 ms), masked visual displays. For example, pre-conscious anxiety-congruent biases have been found on masked versions of the dot probe (Mathews, Ridgeway & Williamson, 1996; Mogg, Bradley & Williams, 1995; Mogg, Bradley & Hallowell, 1994) and colour naming tasks (Bradley, Mogg, Millar & White, 1995; Mogg, Bradley, Williams & Mathews, 1993; MacLeod & Rutherford, 1992; MacLeod & Hagan, 1992). The above findings strongly suggest that anxiety is associated with a bias in pre-conscious and attentional processes, favouring the selection of negative and threatening information.

By contrast, in clinical depression, there have been several failures to find mood-congruent biases when using brief, masked (i.e. subthreshold) stimulus exposure conditions in the dot probe (e.g. Mogg *et al.*, 1995; Mathews *et al.*, 1996) and colour naming task (Bradley *et al.*, 1995; Mogg *et al.*, 1993), Thus, a negative bias in pre-conscious processes does not seem to be a feature of depression.

However, when using longer stimulus exposure (500—1500 ms; i.e. suprathreshold) conditions, findings of depression-related attentional biases have been more variable. The dot probe task has provided evidence of attentional biases for negative information in clinical depression (e.g. Mogg *et al.*, 1995; Mathews *et al.*, 1996), but this finding has not been consistent. For example, Hill and Dutton (1989) and MacLeod and Chong (1997) failed to reveal a negative attentional bias in non-clinical dysphoria. MacLeod *et al.* (1986) also found no such bias in their clinically depressed group, although Mathews *et al.* (1996) noted that the depressed patients were not well matched with the other groups in the latter study. The colour naming task has also provided mixed evidence of depression-congruent biases for negative information shown under suprathreshold conditions. For example, such biases have been found in induced depressed mood by Gotlib and McCann (1984) (Study 1), and in clinical depression by Gotlib and Cane (1987), but not by Mogg *et al.* (1993) or Bradley *et al.* (1995). There are methodological differences between these studies. The word stimuli were presented for 1500 ms in the former two studies (with the words remaining displayed after the colour naming response), but only on average for about 600 ms in the latter two studies (as the response terminated the word display).

A general pattern of results seems to be emerging from the above research. That is, anxiety appears to be associated with a bias in pre-conscious and attentional processes. By contrast, there is no clear evidence of a pre-conscious bias for negative information in depression. Where attentional biases have been found in depression, these have tended to occur on tasks using relatively long exposure durations of 1 sec or more (e.g. Mogg *et al.*, 1995; Gotlib & McCann, 1984, Study 1; Gotlib & Cane, 1987). When stimuli have been displayed for shorter durations, such as 500 ms in the dot probe task, the results have been variable (e.g. Mathews *et al.*, 1996, MacLeod & Chong, 1997).

One way of reconciling these findings is suggested by recent research into selective attention, which indicates that the attentional system is not unitary. For example, Posner and colleagues proposed that three separate subsystems may underlie orienting: attentional shifting, engagement and disengagement (e.g. Posner & Petersen, 1990). A distinction between the shifting and maintenance of attention was also described by Allport (1989) and LaBerge (1995). Thus, anxious individuals may shift their attention towards threat stimuli, as a result of automatic attentional capture arising from a bias in pre-conscious processes. By contrast, depression does not seem to be associated with an initial orienting bias or pre-conscious bias, but once negative information has come into the focus of attention, a depressed individual may have greater difficulty in disengaging attention from such material.

Therefore, two studies were planned to examine the relationship between attentional biases for negative information and depressed mood—both induced (Study 1) and naturally-occurring

(Study 2). We investigated the time course of the attentional bias by manipulating the exposure duration of word stimuli in a dot probe task, similar to that used by Mogg *et al.* (1994, 1995). A series of word pairs was presented, and *S*s responded to probes that replaced one of the words in each pair. In the present study we used three exposure conditions for the word pairs: 14 ms (followed by 186 ms mask), 500 ms, and 1000 ms. The former was intended to restrict awareness of the word stimuli, in order to examine pre-conscious biases. The 500 ms condition has previously been widely used to examine mood-congruent attentional biases in both clinical and non-clinical samples (e.g. Mogg *et al.*, 1994; Mathews *et al.*, 1996), and so was included here as a replication condition. The 1000 ms condition is a sufficiently long duration to allow multiple shifts in attention and gaze between the words of each pair (e.g. the intersaccadic interval during active visual search is in the region of 200–300 ms; Kowler, 1995), and so is likely to be more sensitive to those processes involved in the maintenance of attention.

Following the dot probe task, two forced-choice discrimination tasks were given to assess awareness of the word stimuli presented under the short (14 ms) exposure condition. One task involved discriminating between the presence *versus* absence of words displayed before the mask; the other involved discriminating whether masked words or non-words were shown. Each task provided an objective index of whether or not the word stimuli exceeded *S*s' awareness thresholds (Cheesman & Merikle, 1985).

STUDY 1

Study 1 tested the following hypotheses.

1. Induced depressed mood will produce increased vigilance bias for negative words.
2. The depression-congruent bias will be more evident for relatively long duration stimuli (i.e. depressed mood state is associated with maintained attention to negative material).

In addition, the task included both depression- and anxiety-related words in order to assess the content-specificity of the predicted attentional bias. The α level was set at 0.05 throughout in both studies.

METHOD

Participants

These were 38 student volunteers selected with scores of less than 10 on the Beck Depression Inventory (BDI). This cut-off score was used, following Kendall, Hollon, Beck, Hammen and Ingram (1987), to avoid exposing dysphoric individuals to a depressed mood induction procedure (MIP). Male and female *S*s were randomly allocated to either the depressed or neutral MIP groups. Four *S*s were subsequently excluded: one did not comply with the MIP instructions; one had outlying latency data, and two had above-chance performance on the main awareness check task (see Results for details). Thus, each MIP group comprised 17 *S*s (9 male, 8 female), with a mean age of 21 years.

Materials

Dot probe task. The stimuli included two types of negative word: 36 depression-related words (e.g. hopeless, despair, misery) and 36 anxiety-related words (e.g. disgrace, incurable, attacked), which were taken from previous research (see Bradley *et al.*, 1995, for details of word selection and matching). Each negative word was paired with a neutral word, matched for length and frequency. Another 72 word pairs, comprising a mixture of neutral and positive words, served as fillers. One third of the word pairs of each type was allocated to one of three exposure conditions (short, medium or long). Three versions of the task were constructed so that the allocation of word sets to each exposure condition was balanced across *S*s. The equipment included an IBM PS\2 computer, IBM 8512 monitor, and MEL software version 1.0 (Schneider, 1988).

Questionnaires

1. Beck Depression Inventory (BDI, Beck, Ward, Mendelson, Mock & Erbaugh, 1961).
2. Shortened state version of the Profile of Mood States (POMS, McNair, Lorr & Droppelman, 1981), consisting of six depression, six tension, and six vigour items.

3. Three visual analogue scales (VASs), assessing 'sad', 'happy', and 'anxious' mood state, were used to monitor variation in mood state over the course of the session (Clark & Teasdale, 1985). Each scale consisted of a line with five labelled anchor points, ranging from 0 (not at all) to 100 (extremely), on which *S*s indicated how they felt 'right now'.
4. State and trait versions of the State Trait Anxiety Inventory (STAI, Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983).
5. Depression Proneness Questionnaire (DPQ, Mathews & Bradley, 1983), in which previous episodes of depression were rated (using three visual analogue scales, each with six labelled anchor points; score ranging from 0 to 100) for frequency (i.e. How often do you feel miserable or sad?), severity (i.e. If/when you get miserable or sad, how bad is it on average?), and duration (i.e. How long does each period of feeling miserable or sad last on average?). The DPQ yields separate scores for each scale, as well as an average depression proneness score for each *S*.
6. Social Desirability Scale (SDS, Crowne & Marlowe, 1964). This was included because need for social approval is a potential confounding variable in self-report measures.

Procedure

The test session was in three phases.

Phase 1: each *S* completed the BDI, POMS, and VAS (Time 1). Those scoring less than 10 on the BDI proceeded to Phase 2 of Study 1; while those scoring 10 or more moved to Phase 2 of Study 2.

Phase 2: *S*s next underwent the MIP. Those in the depressed MIP were instructed to put themselves in a sad mood by recalling unhappy memories from their past, while listening to sad music (Prokofiev's Russia under the Mongolian Yoke, played at half speed) for 7 min. Those in the neutral MIP were told to put themselves in a neutral mood by recalling routine journeys they had taken in the past, while they listened to modern music (Kraftwerk's "Pocket Calculator") for 7 min. These pieces of music have been shown to be effective in manipulating mood in previous studies (e.g. Clark & Teasdale, 1985; Sutton, Teasdale & Broadbent, 1988). Immediately after the MIP, *S*s again completed the POMS and VAS (Time 2).

Subjects then completed the first block of the dot probe task, which consisted of 6 practice and 144 experimental trials. Each trial began with a fixation cross for 500 ms. This was replaced by a word pair, with one word above and the other below the central fixation position. The words were 3.5 cm apart and *S*s were seated about 60 cm from the screen. In the 14 ms exposure condition, the display of the word pair was immediately followed by a pair of random letter masks (e.g. PLKYWS), and the stimulus onset asynchrony (SOA, i.e. interval between the onset of the word pair and the onset of the mask pair) was 14 ms. The masks were presented for 186 ms, and then a dot probe appeared in the location of one of the preceding masks. Subjects pressed one of two keys to indicate whether the probe was in the upper or lower position; their response terminated the probe display. Inter-trial interval was 1000 ms.

The sequence of events in the other two exposure conditions was the same as above, except that no masks were displayed, and the duration of the word pairs was either 500 ms or 1000 ms. Immediately after the display of the word pair, a dot probe appeared in the location of one of the words. Thus, the SOA between the word pair and the probe in the three exposure conditions was 200 ms (i.e. 14 ms word pair and 186 ms mask pair), 500 ms and 1000 ms. In each exposure condition, the emotional word and the probe could appear in either the upper or lower position of the screen with equal probability.

After the first block of trials of the dot probe task, *S*s again completed the VAS (Time 3), and were then given a mood booster procedure, to maintain the induced mood. Subjects received the same instructions as before, and listened to the same piece of music for 3 min. They then completed the VAS (Time 4), and completed the second block of trials of the dot probe task (i.e. another 6 practice and 144 experimental trials). The task and stimuli were the same, except that the trials were shown in a new random order and the positions of the probe differed from those in the first block of trials. Subjects again completed the VAS (Time 5).

Phase 3: two awareness checks were administered—lexical decision and presence/absence discrimination tasks—in counterbalanced order across *S*s. Each task had 8 practice and 48 experimental trials, and used word stimuli taken from the short exposure condition of the dot probe task, with an equal number of each word type. In the lexical decision task, half the trials were similar to those in the short exposure condition of the dot probe task (i.e., 500 ms fixation cross → 14 ms word pair → 186 mask pair). On the other half of trials, a pair of non-words was shown before the masks, instead of a word pair. Subjects were asked to press one of two keys to indicate whether words or non-words were displayed before the masks. They were also told that on half the trials words would be presented briefly before the masks, and were encouraged to guess if uncertain.

In the presence/absence task, half the trials were similar to those described above (i.e. 500 ms fixation cross → 14 ms word pair → 186 mask pair), whereas on the other half of trials, a blank screen was displayed for 14 ms instead of the word pair. Subjects were asked to press one of two keys to indicate whether or not words were presented before the masks (they were again informed that words would be presented on half the trials, and were encouraged to guess if uncertain).

Subjects completed the STAI, DPQ and SDS, and were then debriefed and paid a small fee for their participation. Finally, the VAS was readministered to check that mood had normalised before *S*s' departure. Those in the depressed MIP condition were also offered an opportunity to engage in a positive MIP (listening to cheerful music) to counteract any residual effects of the mood induction.

RESULTS

Awareness checks

Lexical discrimination. The proportion of trials with correct responses was calculated for each *S*. Binomial tests revealed that two had scores which were outside chance limits (scores of 0.67 and 0.71; i.e. outside 95% confidence intervals, $P < 0.05$, two-tailed), and so their data were excluded from all further analyses. The performance of the remaining 34 *S*s did not differ significantly from chance level of 0.50 (mean = 0.49; $t(33) = 1.35$, *ns*), with no significant difference between the two groups. Thus, these results suggest that our final sample of *S*s were unaware of the lexical content of the masked word stimuli.

Presence/absence discrimination. The performance of the 34 *S*s was significantly above chance level of 0.50 (mean = 0.72; $t(33) = 7.89$, $P < 0.01$), with no significant difference between the two groups. Binomial tests showed that the performance of 59% *S*s was significantly above chance level on this task. These results suggest that a substantial proportion of *S*s were able to detect the presence of word stimuli in the masked condition, despite being unable to identify their lexical content.

Effect of MIP on mood

See Table 1 for mean questionnaire scores. Kolmogorov–Smirnov tests showed that the distribution of each measure was within normal limits. As expected, the depressed and neutral MIP groups differed significantly only on the POMS and VAS mood state measures taken after the mood manipulation. *t*-Tests showed no significant group differences in BDI, STAI, DPQ or SDS scores ($P < 0.05$). To assess the effect of the MIP on mood state, a 2 × 2 ANOVA was carried out on each POMS measure, with MIP group (depressed, neutral) as a between-*S*s variable, and time (before MIP, after MIP) as a within-*S*s variable. Each POMS measure showed a significant MIP × Time interaction (POMS-depression: $F(1,32) = 48.50$, $P < 0.01$; POMS-tension-anxiety: $F(1,32) = 7.28$, $P < 0.01$; POMS-vigour: $F(1,32) = 23.11$, $P < 0.01$). There were no significant differences between the groups in POMS scores before the MIP. However, *S*s reported more depression and tension-anxiety, and less vigour after the depressed MIP, compared with those who received the neutral MIP.

Table 1. Study 1: characteristics of MIP groups

	Neutral MIP	Depressed MIP	$t(32)$	p
Gender ratio (M/F)	9/8	9/8		
Age	20.6	21.0	0.34	ns
Beck Depression Inventory	4.9	4.3	0.73	ns
STAI-trait anxiety	40.8	40.5	0.10	ns
STAI-state anxiety	39.9	43.6	1.17	ns
Depression Proneness Questionnaire				
Severity	57.4	52.0	1.19	ns
Frequency	40.9	40.8	0.04	ns
Duration	50.4	52.5	0.61	ns
Social Desirability Scale	12.8	12.9	0.04	ns
POMS-depression				
Time 1 (before MIP)	1.2	0.9	0.33	ns
Time 2 (after MIP)	0.6	7.2	7.24	< 0.001
POMS-anxiety				
Time 1 (before MIP)	4.9	5.3	0.32	ns
Time 2 (after MIP)	3.1	6.8	3.05	< 0.01
POMS-vigour				
Time 1 (before MIP)	9.4	10.6	0.92	ns
Time 2 (after MIP)	6.2	1.9	4.11	< 0.001

Note: STAI, State Trait Anxiety Inventory; POMS, Profile of Mood States (short-form).

To assess mood change during the session, a 2×5 ANOVA was carried out for each VAS measure with MIP group (depressed, neutral) as a between-*S*s variable, and time (1 = before MIP; 2 = after MIP; 3 = after first half of dot probe task; 4 = after mood booster; 5 = after second half of dot probe task) as a within-*S*s variable. Each VAS measure showed a significant MIP group × Time interaction (VAS-sad: $F(4,29) = 22.18$, $P < 0.01$; VAS-anxious: $F(4,29) = 4.11$, $P < 0.01$; VAS-happy: $F(4,29) = 8.73$, $P < 0.01$). *Post hoc* tests showed that at each assessment time after the MIP (i.e. Times 2–5), *S*s in the depressed mood condition reported higher levels of VAS-sadness than those in the neutral mood condition ($P < 0.05$; see Fig. 1 for means). However, with regard to VAS-anxiety scores, *S*s in the depressed MIP group reported significantly more anxiety than those in the neutral MIP group on only one occasion, i.e. immediately after the main MIP (Time 2). The depressed MIP *S*s also reported significantly less VAS-happiness than neutral MIP *S*s immediately after the main MIP and again after the mood booster (Time 2 and 4).

In conclusion, the mood manipulation was effective as *S*s reported feeling more depressed and sad after the depressed MIP, compared with the neutral MIP. These significant group differences in depressed mood were sustained over the course of the dot probe task. The depressed MIP was also associated with increased anxious mood, and reduced vigour and happy mood, but these latter mood changes seemed to be less well maintained during the attentional task.

Post-experimental mood check. The final set of VAS measures, taken after the last batch of questionnaires, showed no significant differences between the depressed and neutral MIP groups, indicating no persistent effects of the MIP.

Dot probe task

Latency data were excluded from trials with errors, or if they were less than 200 ms or more than 2000 ms. Also, outlying data that were more than 2 *sd*s above each *S*'s mean were discarded. One *S* had a large proportion of outliers (mean $RT > 3$ *sd*s above sample mean), and consequently was excluded from further analyses. For the final sample of 34 *S*s, the proportions of data lost due to errors and outliers were 0.008 and 0.031 respectively, with no significant difference between the MIP groups.

Mean latencies were calculated for each type of negative word, in each condition, for each *S* (see Table 2 for means). A $2 \times 2 \times 3 \times 2 \times 2$ ANOVA was carried out of the latency data with one between-*S*s variable of MIP group (2: depressed, neutral), and four within-*S*s variables: negative word type (2: depression-related, anxiety-related), exposure condition (3: 14 ms, 500 ms, 1000 ms), position of the negative word (2: upper, lower) and position of the probe (2: upper, lower). For the sake of brevity, only results which are relevant to the hypotheses will be considered (i.e. those involving a Negative word position × Probe position interaction). There was a

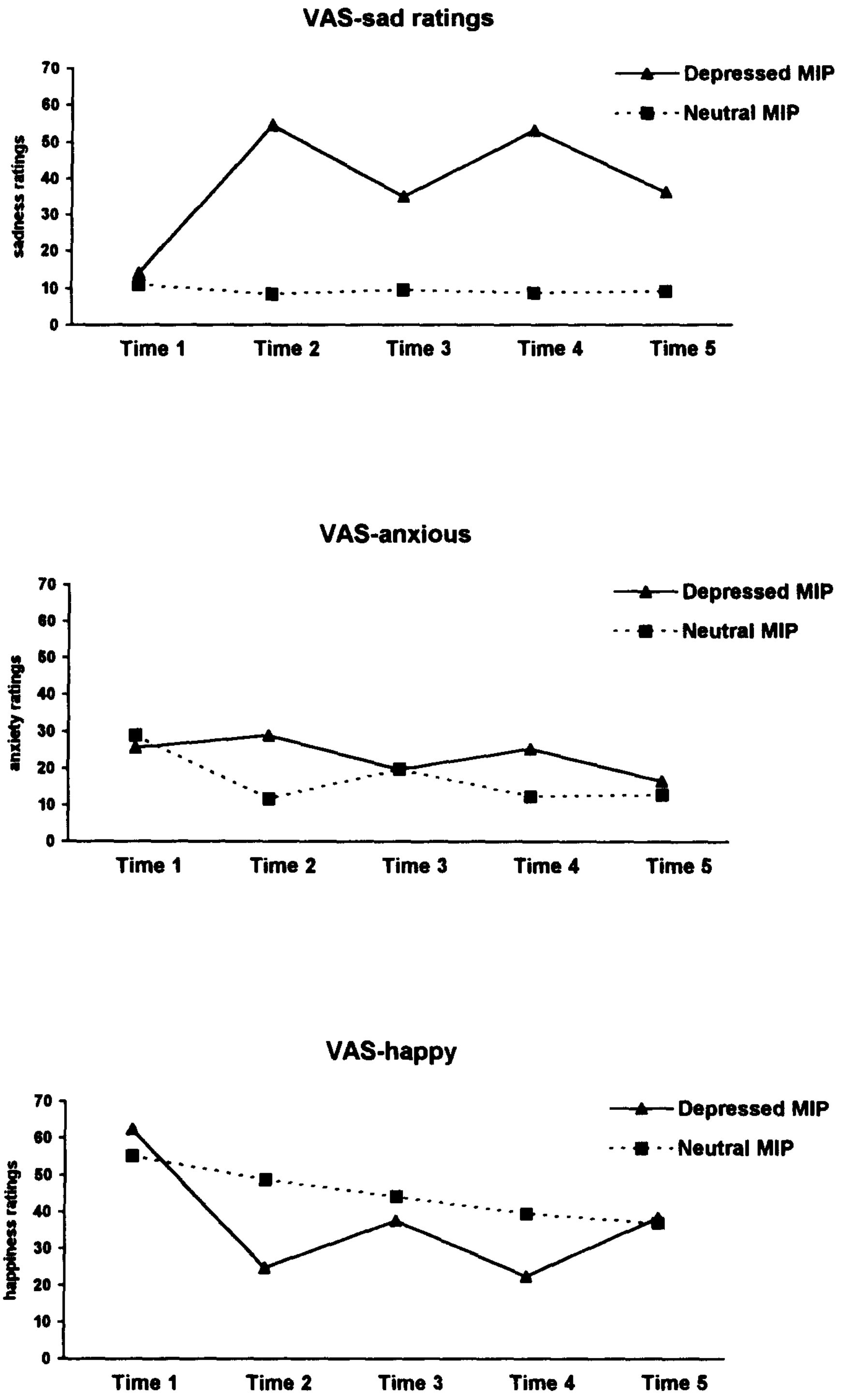

Fig. 1. Study 1: mean VAS ratings of sad, anxious and happy mood for depressed and neutral MIP groups (Time 1 = before MIP; 2 = after MIP; 3 = after first half of dot probe task; 4 = after mood booster; 5 = after second half of dot probe task).

Table 2. Study 1: mean probe detection latencies (in ms) of MIP groups

Type of negative word	Exposure	Negative word position	Probe position	Neutral MIP	Depressed MIP
Depression-related	Short	Upper	Upper	437	450
		Upper	Lower	469	465
		Lower	Upper	443	463
		Lower	Lower	476	484
	Medium	Upper	Upper	455	455
		Upper	Lower	463	495
		Lower	Upper	444	462
		Lower	Lower	473	487
	Long	Upper	Upper	458	456
		Upper	Lower	473	496
		Lower	Upper	449	454
		Lower	Lower	474	474
Anxiety-related	Short	Upper	Upper	442	460
		Upper	Lower	474	487
		Lower	Upper	439	462
		Lower	Lower	460	484
	Medium	Upper	Upper	436	451
		Upper	Lower	471	478
		Lower	Upper	450	446
		Lower	Lower	470	480
	Long	Upper	Upper	448	459
		Upper	Lower	474	485
		Lower	Upper	444	458
		Lower	Lower	475	473

significant four-way interaction of MIP group × Negative word type × Negative word position × Probe position ($F(1,32) = 4.36$, $P < 0.05$), and a significant five-way interaction of MIP group × Exposure × Negative word type × Negative word position × Probe position ($F(2,31) = 3.23$, $P = 0.05$).

To simplify these results, attentional bias scores were calculated for each condition (i.e. for each negative word type and exposure condition) for each *S* by subtracting the mean latencies when probes were in same position as the negative words from the mean latencies when probes were in different positions to the negative words (Mogg *et al.*, 1995). This is also expressed by the following equation: Attentional bias score = [(NuPl + NlPu) − (NuPu + NlPl)]/2 where N = negative word, P = probe, u = upper, l = lower (e.g. NuPl represents the mean response time when the negative word is in the upper position and the probe is in the lower position). The bias score summarises the Negative Word Position × Probe Position interaction effect on response latencies. It provides a measure of the relative speeding of response latencies to probes which appear in the same location as negative words. Positive values score reflect vigilance for negative words relative to neutral words, while negative values reflect avoidance.

A 2 × 2 × 3 ANOVA of attentional bias scores—with MIP group, negative word type and exposure as variables—showed a significant MIP group × Negative word type interaction ($F(1,32) = 4.36$, $P < 0.05$), and MIP group × Exposure × Negative word type interaction ($F(2,31) = 3.23$, $P = 0.05$; the latter result corresponds to the five-way interaction found in the latency data). To clarify the three-way interaction, illustrated in Fig. 2, separate ANOVAs were used to compare the groups on bias scores in each exposure condition. With regard to depression-related words, *S*s in the depressed MIP group showed significantly more vigilance for these stimuli in the 500 ms, condition compared with neutral MIP *S*s ($F(1,32) = 6.69$, $P < 0.05$). There was a similar trend in the 1000 ms condition ($F(1,32) = 3.13$, $P < 0.09$), but no evidence of a group difference in bias scores for depression words in the 14 ms condition ($F(1,32) = 0.07$, *ns*). For anxiety-related words, there were no significant group differences in any exposure condition.

Correlations. To examine the relationship between the attentional bias for depression words and mood state, correlations were calculated between the bias scores in each exposure condition and POMS scores obtained immediately after the MIP. POMS-depression correlated significantly with the bias for depression words in the 500 ms condition ($r = 0.36$, $P < 0.05$); and

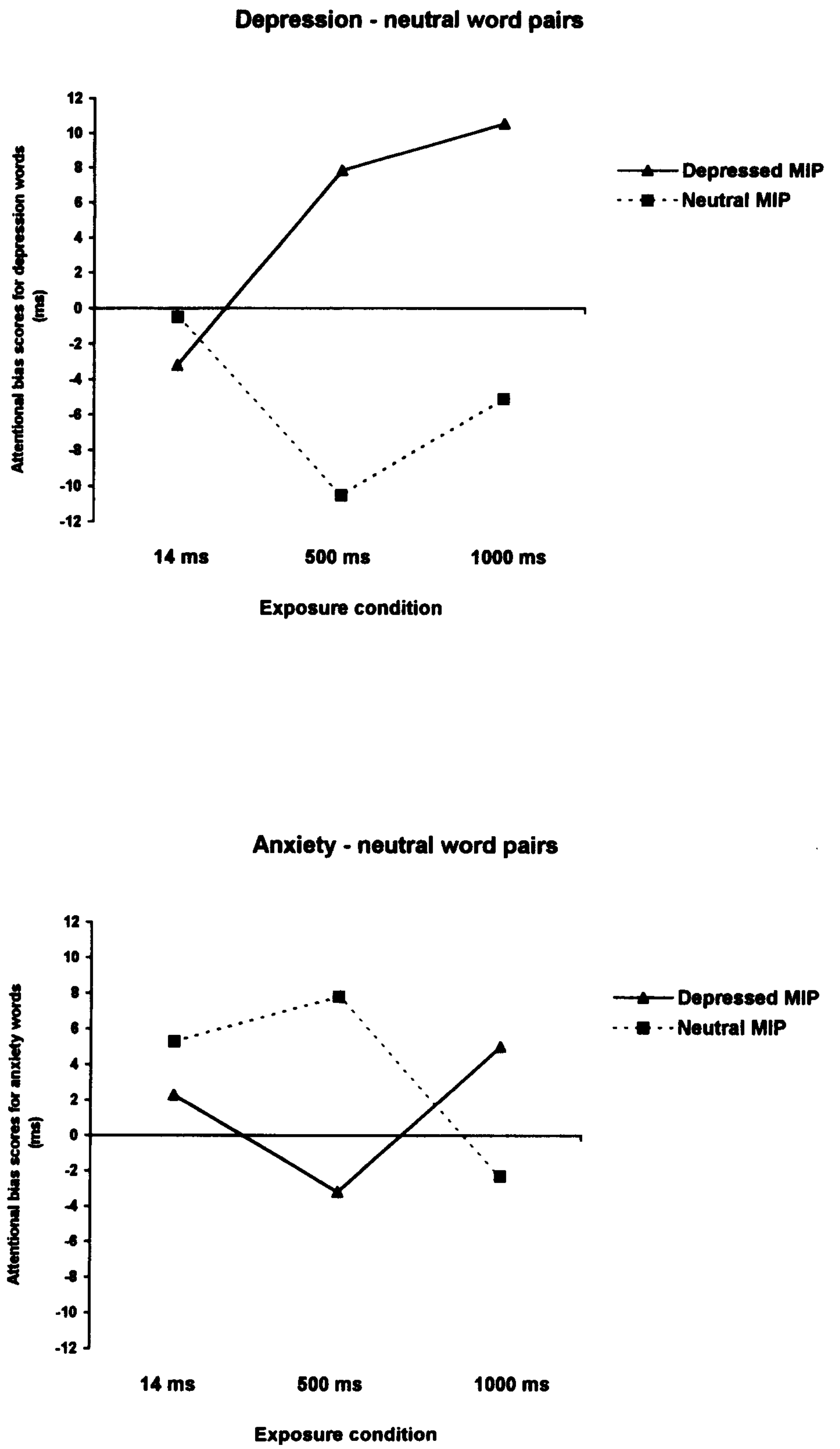

Fig. 2. Study 1: attentional bias scores for negative words in depressed and neutral MIP groups.

POMS-tension-anxiety correlated with the bias in both the 500 ms ($r = 0.38$, $P < 0.05$) and 1000 ms ($r = 0.37$, $P < 0.05$) conditions.

Partial correlations did not clarify the relative contributions of POMS-tension-anxiety and depression to these biases (when depression was controlled the correlation with tension-anxiety was no longer significant, and *vice versa*), suggesting that the attentional bias for depression words in the 500 ms and 1000 ms conditions may be associated with a common underlying variable, such as state negative affect.

Summary. The MIP was effective in manipulating depressed mood. On the dot probe task, in comparison with neutral MIP *S*s, those in the depressed MIP showed greater vigilance for depression words in the 500 ms exposure condition, and a similar near-significant trend in the 1000 ms condition. There was no evidence of a depression-congruent bias for stimuli in the 14 ms masked exposure condition.

STUDY 2

This study tested the following hypotheses for naturally occurring dysphoria:

1. Naturally occurring dysphoria is associated with increased vigilance for negative words. This bias will be more evident for relatively long duration stimuli, i.e. depressed mood is associated with maintained attention to negative material.
2. High trait anxiety is associated with a pre-conscious bias for anxiety-related words (i.e. replication of a finding by Mogg *et al.*, 1994).

METHOD

Subjects

These were 46 student volunteers, including those who had not been accepted into Study 1 because they had BDI scores above 10 (the cut-off for the non-dysphoric range) Five were excluded for the following reasons: outlying age (1 over 60 years), a coding error (1), difficulty following instructions as first language was not English (1), above chance performance on the main awareness check task (1), and outlying latencies (1) (see Results for details). Thus, there were 41 *S*s, comprising 28 men and 13 women, with a mean age of 21 years. Twenty five *S*s had BDI scores greater than or equal to the cut-off of 10 (dysphoric group), while 16 *S*s scored below 10 (non-dysphoric).

Materials. Materials were the same as in Study 1.

Procedure

There were three phases.

Phase 1: as in Study 1 (i.e. BDI, POMS and VAS).

Phase 2: as in Study 1 (i.e. dot probe task), except that no MIP or mood booster procedure was used.

Phase 3: as in Study 1 (i.e. awareness checks, STAI, DPQ, SDS, and a small fee were given).

RESULTS

Awareness checks

Lexical discrimination. Binomial tests were carried out on the proportion of correct trials for each *S*. One *S* scored outside chance limits (0.67), and so was excluded from all subsequent analyses. The remaining 41 *S*s did not differ significantly from chance (mean = 0.48; $t(40) = 1.52$, *ns*).

Presence/absence discrimination. The whole sample performed significantly above chance level (mean = 0.65; $t(40) = 5.23$, $P < 0.01$). Binomial tests showed that 39% of *S*s were significantly above chance level. The pattern of results from the awareness checks are consistent with Study 1.

Dot probe task

Errors and outliers were excluded as described in Study 1. One *S* had outlying latencies (mean $RT > 3$ *sd* above sample mean), and so was excluded from further analyses. For the final sample of 41 *S*s, the proportion of data lost due to errors and outliers was 0.005 and 0.035 respectively.

Mean latencies were calculated for each type of negative word, in each exposure condition, for each *S*. A $2 \times 2 \times 3 \times 2 \times 2$ ANOVA was carried out with one between-*S*s variable of BDI group (2: non-dysphoric, dysphoric), and four within-*S*s variables: negative word type (2: depression-related, anxiety-related), exposure condition (3: 14 ms, 500 ms, 1000 ms), position of the negative word (2: upper, lower) and position of the probe (2: upper, lower). There were no significant results involving a Negative word position × Probe position interaction.

To test our second hypothesis, the ANOVA was repeated after reallocating *S*s into high or low trait anxiety groups, depending on whether or not their trait anxiety scores were greater than the median of 41 (20 low trait, 21 high trait *S*s; see below for sample details). Thus, there were four within-*S*s variables, as above, and one between-*S*s variable of trait anxiety (high, low). The results showed a significant four way interaction of Trait anxiety × Exposure × Negative word position × Probe position ($F(2,38) = 3.35$, $P < 0.05$); see Table 3 for means. This interaction was not significantly influenced by negative word type ($F(2,38) = 2.12$, $P = 0.14$).

To simplify the significant four-way interaction, attentional bias scores were calculated for each negative word type and exposure condition, for each *S*, as described in Study 1. A $2 \times 2 \times 3$ ANOVA of attentional bias scores showed a significant Group × Exposure interaction ($F(2,38) = 3.35$, $P < 0.05$; this result is equivalent to the four-way interaction found in the latency data). To clarify this two-way interaction, the groups were compared on their bias scores for negative words (i.e. averaged across anxiety and depression word types) in each exposure condition. The high trait anxiety group showed significantly greater vigilance for negative words in the 14 ms masked exposure condition compared with low trait anxiety *S*s (mean bias scores were 4 ms and −8 ms, respectively, $F(1,39) = 4.48$, $P < 0.05$). There were no significant group differences in bias scores for negative words in either the 500 ms ($F(1,39) = 1.97$, *ns*) or 1000 ms exposure conditions ($F(1,39) = 0.94$, *ns*).

Questionnaire measures

Details of the trait anxiety and BDI groups are given in Table 4. *t*-Tests were used to compare the groups on their questionnaire scores (POMS-depression scores were square root transformed before all analyses to correct their skewed distribution). The trait anxiety groups differed significantly on all measures, except the duration of past episodes of depression on the DPQ and social desirability. Comparison of the BDI groups showed a similar pattern of results, although the group difference in POMS-Vigour did not reach significance.

Correlations. These were calculated to examine the relationships between attentional bias scores for negative words in each exposure condition and the depression and anxiety measures of STAI, BDI, POMS and DPQ. There were four significant results (5% level, two-tailed): the bias score for negative words in the 14 ms exposure condition correlated 0.31 ($P < 0.05$) with trait anxiety. The attentional bias score for negative words in the 1000 ms condition correlated 0.32 ($P < 0.05$) with Beck depression scores, 0.32 ($P < 0.05$) with mean Proneness to Depression scores, and 0.40 ($P < 0.05$) with the severity of past episodes of depression.

Partial correlations were subsequently conducted, given our specific hypotheses regarding anxiety- and depression-related biases. After controlling the effect of Beck depression, the bias for negative words in the 14 ms condition remained positively correlated with trait anxiety ($r = 0.27$, $P < 0.05$, one-tailed). By contrast, when trait anxiety was controlled, this bias score showed no correlation with BDI ($r = -0.05$, *ns*).

Table 3. Study 2: mean probe detection latencies (in ms) of trait anxiety groups

Type of negative word	Exposure	Negative word position	Probe position	Low trait anxiety	High trait anxiety
Depression-related	Short	Upper	Upper	478	458
		Upper	Lower	498	487
		Lower	Upper	468	456
		Lower	Lower	496	486
	Medium	Upper	Upper	473	444
		Upper	Lower	501	476
		Lower	Upper	484	455
		Lower	Lower	494	478
	Long	Upper	Upper	493	461
		Upper	Lower	488	484
		Lower	Upper	482	463
		Lower	Lower	502	482
Anxiety-related	Short	Upper	Upper	486	441
		Upper	Lower	488	474
		Lower	Upper	473	460
		Lower	Lower	500	475
	Medium	Upper	Upper	478	456
		Upper	Lower	496	473
		Lower	Upper	480	449
		Lower	Lower	483	482
	Long	Upper	Upper	483	463
		Upper	Lower	494	483
		Lower	Upper	496	477
		Lower	Lower	500	488

With regard to the bias score for negative words in the 1000 ms exposure condition, this remained positively correlated with mean Proneness to Depression scores (r = 0.35, P = 0.01, one-tailed), severity of previous episodes of depression (r = 0.35, P = 0.01, one-tailed), and also with Beck depression scores (r = 0.26, P = 0.05, one-tailed), after controlling the effect of trait anxiety scores. After controlling BDI, this bias score showed no correlation with trait anxiety (r = − 0.03, *ns*).

Do the present results replicate our previous findings (Mogg et al., 1994)? A 2 × 3 ANOVA of attentional bias scores—with trait anxiety and exposure as independent variables—was carried out for anxiety words only (depression words were not included in our 1994 study). This showed a significant Trait Anxiety × Exposure interaction ($F(2,38) = 3.95$, $P < 0.05$). High trait anxious *S*s showed more vigilance for anxiety words in the 14 ms exposure condition than low trait *S*s (mean bias scores were 9 ms *versus* −13 ms, respectively, $F(1,39) = 6.53$, $P < 0.05$). The groups did not differ significantly in bias scores in the 500 ms or 1000 ms conditions ($F(1,39) = 3.40$ and 0.01, respectively, *ns*). These results replicate our previous finding that high trait anxious individuals tested under no stress conditions showed a pre-conscious bias for anxiety words, compared with low trait anxious *S*s.

Summary. Results indicate that attentional biases for negative words are an interactive function of the emotional state of the individual and the exposure condition of the negative stimuli. Specifically, increased trait anxiety was associated with a greater bias to shift attention towards the spatial location of negative words presented under conditions of restricted awareness. Correlations indicated that higher depression measures (BDI, depression proneness and severity of previous episodes of depression) were associated with greater vigilance for negative stimuli presented in the longer exposure condition (1000 ms).

DISCUSSION

The results of Studies 1 and 2 are consistent in indicating that both induced and naturally occurring dysphoria are associated with a negative attentional bias under certain conditions. These findings lend support to recent results from clinical studies indicating depression-related biases in selective attention (e.g. Mathews *et al.*, 1996; Mogg *et al.*, 1995). The present results also highlight the importance of examining the time course of attentional biases. Specifically, in Study 1, the depressed mood induction procedure elicited an attentional bias for depression-re-

Table 4. Study 2: characteristics of BDI and trait anxiety groups

	Low BDI	High BDI	$t(39)$	p
Gender ratio (M/F)	12/4	16/9		
Age	20.8	20.6	0.23	ns
Beck Depression Inventory	4.9	14.1	6.13	<0.001
STAI-trait anxiety	37.1	49.5	4.56	<0.001
STAI-state anxiety	34.5	47.0	3.67	<0.01
Depression Proneness Questionnaire				
Severity	50.7	66.5	3.55	<0.01
Frequency	37.5	60.0	4.65	<0.001
Duration	48.0	55.5	1.67	ns
Social Desirability Scale	13.3	12.1	0.72	ns
POMS-depression	1.6	5.5	4.79	<0.001
POMS-anxiety	3.8	8.4	2.89	<0.01
POMS-vigour	10.7	8.2	1.71	ns
	Low trait anxiety	High trait anxiety	$t(39)$	p
Gender ratio (M/F)	14/6	14/7		
Age	20.6	20.8	0.34	ns
Beck Depression Inventory	6.8	14.0	4.24	<0.001
STAI-trait anxiety	35.3	53.5	11.99	<0.001
STAI-state anxiety	34.5	49.4	4.97	<0.001
Depression Proneness Questionnaire				
Severity	51.4	68.8	4.14	<0.001
Frequency	40.3	61.6	4.44	<0.001
Duration	51.5	53.8	0.51	ns
Social Desirability Scale	13.9	11.3	1.63	ns
POMS-depression	1.3	6.5	5.98	<0.001
POMS-anxiety	3.5	9.6	4.19	<0.001
POMS-vigour	10.9	7.6	2.47	<0.05

Note: STAI, State Trait Anxiety Inventory; POMS, Profile of Mood States (short-form).

lated words when the stimuli were presented for 500 ms; with a similar trend in the 1000 ms exposure condition. In Study 2, the attentional bias for negative words in the 1000 ms condition was significantly associated with Beck Depression and Proneness to Depression scores (even when the effect of trait anxiety was partialled out). By contrast, there was no evidence from either study that depressed mood was associated with a bias for briefly presented, masked stimuli (i.e. 14 ms condition). This is consistent with other failures to find pre-conscious biases in clinical depression on selective attention tasks (e.g. Bradley *et al.*, 1995; Mathews *et al.*, 1996; Mogg *et al.*, 1993; 1995). These null findings cannot simply be attributed to insensitive tasks because each of these studies—as well as Study 2 reported here—showed evidence of pre-conscious biases associated with high trait or clinical anxiety.

This general pattern of results seems consistent with the hypothesis that we advanced earlier (see also Mogg *et al.*, 1995). That is, in depression, the selective bias for negative information does not operate throughout all aspects of selective attention. As Posner (1995) and LaBerge (1995) have suggested, selective attention is not a unitary process. Instead, it is important to distinguish between different components, such as shifting *versus* maintenance. Attentional shifting is a rapid process; for example, shifts in covert attention occur in less than 100 ms and typically precede shifts in overt orienting (eye movements) which are relatively slower, such as every 200–300 ms on average in visual search (e.g. LaBerge, 1995; Klein *et al.*, 1992).

Thus, in depression, there is no evidence of a negative bias in early automatic aspects of attentional processing, such as pre-conscious processes involved in attentional capture and in initial shifts in orienting. By contrast, there is growing evidence that high trait anxiety and generalised anxiety disorder are associated with a pre-conscious selective bias for negative information (e.g. MacLeod & Hagan, 1992; Bradley *et al.*, 1995; Mogg *et al.*, 1993, 1995). Indeed, the results from Study 2 successfully replicate a key finding from our previous non-clinical study using the dot probe task (Mogg *et al.*, 1994). That is, high trait anxious individuals tested under normal conditions (i.e. no stressor or MIP) showed an attentional bias to the spatial location of briefly presented, masked negative words, in comparison with low trait anxious individuals. This is consistent with an anxiety-related pre-conscious bias. The results of Study 2 not only confirmed this finding but also suggested that this bias was independent of the effect of depression (in our previous study, the trait-anxiety-related pre-conscious bias remained evident after statistically controlling the effect of Beck Depression scores). Further support for the view that anxiety, but not depression, is associated with a bias in initial orienting comes from a recent study in our laboratory showing that individuals with generalised anxiety disorder, but not those with depressive disorder, were more likely to shift their gaze towards threatening faces, relative to neutral or happy faces (Mogg, Bradley & Millar, in preparation).

In another recent non-clinical study using the dot probe task we found significant evidence that high state anxiety was associated with vigilance for threat words presented in a short exposure condition (100 ms), consistent with a bias in the initial shift of attention to threat (Mogg, Bradley, de Bono & Painter, 1997). There were also non-significant trends towards similar vigilance in the longer exposure conditions (500 and 1500 ms), but it was unclear whether the latter trends were a function of anxiety or depression. Thus, despite different criteria for selecting participants (our other study included unselected normal volunteers and so there was a relatively small proportion with high trait anxiety and BDI scores), both studies are consistent in indicating an anxiety-related bias in initial vigilance for negative stimuli.

There is also growing evidence that non-clinical dysphoria and clinical depression are associated with a negative bias on attentional tasks, but this seems to be mainly found when the stimuli are shown for longer durations, such as 500–1000 ms on the dot probe task (e.g. Studies 1 and 2; Mathews *et al.*, 1996; Mogg *et al.*, 1995). One explanation of these findings is that, although depressed individuals may not automatically orient their attention towards negative information in the environment, once such material has come into the focus of their attention, they may have greater difficulty in disengaging their attention from it. In other words, depression may be primarily associated with a bias in the maintenance of attention (rather than initial shifting) to negative information. This would be consistent with the view that an increased tendency to ruminate on negative information, together with difficulty in distracting oneself from such material, may play an important role in maintaining depressed mood (Nolen-Hoeksema, 1991).

As a note of caution, it should be mentioned that two non-clinical studies failed to show attentional biases associated with naturally occurring dysphoria (Hill & Dutton, 1989; MacLeod & Chong, 1997). Such null findings might arise from methodological issues. For example, it seems probable that such biases are more fragile in non-clinical samples than in clinical depression. Also, the earlier version of the dot probe task used by Hill and Dutton (1989) is not ideal because the probability of occurrence of a negative word and that of a probe were not independent. The modified version of the dot probe task used here and in Mogg *et al.* (1994, 1995) avoids this potential problem.

The present results lend further support to the view that depression is associated with a bias in selective attention to negative information under certain conditions. Moreover, as Mathews *et al.* (1996) pointed out, such findings are problematic for one aspect of Williams *et al.*'s (1988) model which proposed that such biases are not a feature of depression. To help clarify this issue, future research should not simply address the question of whether or not an attentional bias is associated with different emotional states, but instead should investigate systematically which particular components of selective attention processes are implicated (e.g. initial shifts in orienting versus maintenance).

One aspect of Williams *et al.*'s (1988) hypothesis has received support, namely, that anxiety is associated with a bias in automatic pre-conscious processes, as revealed by performance on selective attention tasks. However, in the light of recent research findings, it seems necessary to examine more carefully the precise characteristics of the tasks that reveal pre-conscious biases. Specifically, it seems premature to conclude that there are no biases in any aspect of pre-conscious processes in depression. Indeed, most cognitive formulations of depression (e.g. Beck, 1976; Bower, 1981; Moretti & Shaw, 1989; Ingram, 1984), except Williams *et al.*'s, have proposed that depression is associated with a bias in automatic aspects of information processing. Several studies in our laboratory have indicated the presence of depression-congruent priming effects in pre-conscious processes on implicit memory tasks (e.g. repetition and semantic priming effects due to briefly presented, masked primes) in both non-clinical dysphoria and in clinical depression (Bradley, Mogg & Williams, 1994, 1995; Bradley, Mogg & Millar, 1996; Scott, Mogg & Bradley, 1997). Thus, there seems to be growing evidence of depression-congruent pre-conscious biases on priming tasks, but not of such pre-conscious biases on selective attention tasks. One possible explanation of such findings is that depression is associated with a bias in both automatic and strategic aspects of memory (including pre-conscious priming and recall effects), as well as in sustained attention to negative information. By contrast, anxiety, but not depression, is associated with a bias in automatic shifting of selective attention to threat stimuli in the environment (i.e. bias in pre-conscious processes involved in capture of visuo-spatial attention, and in initial orienting to external stimuli).

With regard to the present studies, two further issues concern the roles of state *versus* trait mood variables on biases in selective attention processes. The results of Study 1 suggested that inducing a transient dysphoric mood was sufficient to elicit vigilance for depression-related information in the longer exposure durations. However, it was unclear from partial correlations whether this induced vigilance was a function specifically of depressed or anxious mood, which raises the possibility that the bias was a function of negative affect in general. This issue could be usefully addressed in future by including more sensitive measures developed from Clark and Watson's (1991) tripartite model, which are more likely to discriminate between the relative influences of anxiety, depression and negative affect (Watson, Weber, Assenheimer, Clark, Strauss & McCormick, 1995).

The finding that the depressed MIP group showed greater vigilance for depression words in the longer exposure duration conditions than the neutral MIP group is of interest given that the volunteers had not been selected on the basis of their vulnerability to depression. Indeed, the study was not specifically designed to assess the extent to which such biases are an interactive nation of dysphoric mood state and proneness to depression. Thus, it would now seem timely to investigate this issue further, given research suggesting that other biases in information processing, such as dysfunctional beliefs or negative recall biases, depend on an interactive relationship between current depressed mood and prior vulnerability (e.g. Miranda, Persons & Byers, 1990; Bradley & Mogg, 1994; Teasdale & Dent, 1987).

In summary, the present studies suggest that depression and anxiety are associated with biases in different aspects of attentional processes. Anxiety appears to be linked mainly with a bias in pre-conscious processes involved in initial orienting to negative stimuli, whereas depression seemed more closely associated with a bias in later aspects of processing, such as those involved in sustained attention.

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