A Search for Specificity: Attentional bias in Anxiety, Depression, and Borderline Personality Disorder

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Abstract

Distractions by emotional stimuli have been studied in non-clinical and clinical populations to identify attentional biases that may provide information relevant to assessing and treating emotional disorders. These studies of attentional bias have frequently employed the emotional Stroop and dot probe tasks. However, results from studies on attentional bias in emotional disorders that have used these tasks have been varied and it remains unclear if disorder-specific biases exist. A dimensional study, utilizing both measures of broad psychopathology constructs and more specific subcomponents, was conducted to investigate these inconsistencies. Results suggest that while the relationship of attentional bias to the broad, disorder based constructs of anxiety, depression, and BPD is unclear, research which focuses on more specific aspects of these psychopathologies may provide clearer answers as to the specificity of attentional bias. Greater understanding of the relationship between attentional bias and facets of psychopathology promises to benefit clinical treatment through the use of attentional bias modification training.

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Cognition and Attention

The broad concept of cognition involves many cognitive processes such as perception, memory, cognitive control, and attention. Attention itself, using a component-processes approach, can be broken down into simpler component processes such as early and late attentional processes. (Sanislow, et al., 2010). Of particular importance to the study of attention is the concept of selective attention: the complex process involved when individuals select what to attend to and further process from the vast number of stimuli in their internal and external environment According to the biased competition model of attention, individuals have a limited capacity for sensory perception and further processing and therefore are limited in what they are able to pay further attention (Mueller-Pfeiffer, et al., 2010).

Researchers and theorists who examine selection tendencies of individuals or groups have used the term attentional bias, which will be used in this paper. This term refers to the systematic tendency to allocate attention to a particular type of group of stimuli (Harvey, Watkins, Mansell, & Shafran, 2004). Attentional bias can be a tendency to attend to a particular group or a tendency to avoid a particular group (attentional avoidance). The tendency to attend to threatening stimuli in particular is called hypervigilance. These tendencies can occur in both early and late perceptual processes. It has been theorized that some groups of individuals are characterized by specific and distinct attentional biases and much work has been done to find evidence for the existence of attentional biases in anxiety disorders, depression, eating

disorders, the elderly, etc. Research in the area usually attempts to find differences in measures of attention to certain types of stimuli between certain groups.

The presence of a bias in attention towards certain stimuli can be explained from an evolutionary perspective. For instance, sensitivity towards items indicating nourishment, such as food, or towards stimuli indicating danger, such as a threatening animal, would both prove beneficial to an individual's survival. However, in the wrong context or when overdeveloped, it appears that this bias may be too strong to remain beneficial or may have negative impacts on an individual's functioning and mental health. It is hypothesized that these malfunctioning biases are related to mental health problems including anxiety and mood disorders. Several assumptions must be made to explain this hypothesis, the foremost of which is the idea that cognitions can have a role in the maintenance of disorders through cognitive biases, as these biases cause individuals to focus on negative information or ignore positive information (Andrews, Charney, Sirovatka, & Regier, 2009). There is also an assumption that this tendency to focus on information relevant to the given disorder increases vulnerability to developing that disorder. As discussed, the biased competition model of attention theorizes that attending to one class of stimulus decreases the amount of cognitive resources, including attention, that may be focused on other classes of stimuli (Mueller-Pfeiffer, et al., 2010). For example, attentional biases in the allocation of perceptual resources may cause individuals to miss information that would contradict the problematic beliefs they have developed because it causes them to attend only to information consistent with their concerns.

Cognitive Theories of Psychopathology

Many specific cognitive theories have been developed in an effort to explain how cognition may interact with emotional affect to cause difficulties. Cognitive theorists have proposed that an individual's or group's ways of attending to, interpreting, and remembering events may contribute to the development and maintenance of psychopathology(Teasdale, 1988). Although explanations may sometimes come from dysfunctions in memory or interpretation, they have often drawn upon the process of attention in an attempt to explain the cause or maintenance of disorders. Attention is an important and early process in the cognitive system and therefore differences in the material that individuals pay attention to and accumulate have implications for different emotional disorders.

Anxiety. Most cognitive models of psychopathology posit that the types of stimuli that are the focus of attentional biases are disorder specific (Hankin, Gibb, Abela, & Flory, 2010). Attentional bias is most often used to explain the etiology and maintenance of anxiety disorders. It is hypothesized that these disorders involve an attentional bias to environmental cues that goes beyond the attention necessary for survival, resulting in heightened anxiety. Specifically, cognitive theories suggest that these disorders as a whole are characterized by a heightened attention to threat-related information. This heightened attention might manifest as an increased awareness of possible threats in the environment, or may result in a bias for interpreting ambiguous stimuli or situations in a threatening manner. Most research on attentional bias in this group has involved the former explanation, but some research has also investigated responses to ambiguous words that have a possible threat meaning (Andrews, et al.,

2009). The increased attention to, or perception of, threatening stimuli may cause individuals to experience increased physiological symptoms of anxiety and therefore to generate excessive worry (Mueller-Pfeiffer, et al., 2010).

Depression. Though cognitively based hypotheses about depression have been less frequent, some cognitive theorists have tried to provide a possible explanation for depression. In these explanations, depression is characterized by biases to stimuli that convey negative emotions such as hopelessness or loss (Hankin, et al., 2010). This dysfunctional attentional allocation is believed to represent significant vulnerability for developing depression (Gotlib & Krasnoperova, 1998). Beck's theory of depression ascribes much of the onset of depression to cognitive biases, while emphasizing the influence of negative schemas (Teasdale, 1988). In his model, individuals who experience loss or failure in their childhood develop negative schemas concerning these situations. These schemas become reactivated when an individual experiences similar situations later in life, becoming rigid beliefs about the world and the self through which stimuli and events are filtered This attention to schema-congruent negative materials causes the individual to accumulate negative material in their memories as well as reactivate previous negative memories.

Due to their filters, individuals interpret information from the environment in ways that are consistent with their personal schemas including: selectively avoiding positive information, interpreting neutral information as negative, or selectively attending to the negative information available (Gotlib & Krasnoperova, 1998). The result is an attentional bias towards stimuli that express or emphasize sad emotions. There is some evidence that attentional bias to sad faces characterizes both formerly

depressed participants (Fritzsche, et al., 2010) as well as individuals at risk for depression (Fritzsche, et al., 2010; Joormann & Gotlib, 2007; Joormann, Talbot, & Gotlib, 2007). This research supports the idea that these biases have an effect on and/or indicate vulnerability to depression.

However, the evidence for attentional biases in depressed individuals is not as consistent or abundant as the evidence for anxiety disorders; while some researchers have found evidence for depression specific biases, others have not (Mobini & Grant, 2007). Early investigations did not find evidence for an attention bias in depression, but some later studies that used longer stimulus duration times have demonstrated a bias (Gotlib, Kasch, et al., 2004). This is consistent with the theory that there is an attentional bias specific to depression, but that it occurs later on in information processing than the biases seen in individuals with anxiety disorders.

Some researchers in the field believe that rather than biases in attention, individuals with depression are better characterized by biases in the information that is placed into memory, or available for recall (Harvey, et al., 2004). Although more evidence exists for enhanced memory of negative emotional material that is depression-relevant, research using certain paradigms (including dichotic listening and emotional Stroop tasks) has found evidence that supports biases in attention to depression-relevant words. Therefore, further research into the existence of this type of characteristic bias is warranted (Gotlib & Krasnoperova, 1998).

Borderline Personality Disorder. Borderline personality disorder (BPD) is characterized by disturbances of emotional regulation, which suggests that these individuals exhibit biases in the processing of negative emotion (Wingenfeld, et al.,

2009). According to Beck's model, an important factor in the development of borderline personality disorder is a cognitive bias involving certain schemas based on a belief that others can be dangerous and malevolent, whereas the person themselves is powerless and vulnerable and therefore unacceptable. Information that is appropriate to these schemas is prioritized, or harder to either inhibit or disengage from, resulting in biases in early information processing such as attention (Sieswerda, Arntz, Mertens, & Vertommen, 2007). In terms of schemas, BPD is often hypothesized to result from childhood traumas, and therefore it would be expected that individuals with BPD would have specific trauma-related cognitive schemas. This view that childhood traumas are a contributing cause of BPD and therefore BPD would be characterized by biases to trauma-related material is supported both by the high prevalence of childhood traumas in individuals with BPD, and that fact that posttraumatic stress disorder is a frequently comorbid disorder (Zanarini, 1997). These trauma-related schemas may create hypervigilance for the same types of information as individuals with post-traumatic stress disorder (PTSD) exhibit biases towards.

Anxiety has also been recognized as a significant aspect of BPD since early papers describing the disorder (Sieswerda, et al., 2007). Additionally, there is relatively high comorbidity of BPD with anxiety disorders, in particular with panic disorder, social phobia, and PTSD. (Skodol, et al., 1995; Zimmerman & Mattia, 1999). For these reasons, it can be hypothesized that attentional biases, akin to those seen in anxiety, might be seen in individuals with BPD. However, although biases in anxiety and depression have been investigated, very little research has been done into

biases in information processing in BPD. To this date, the only study that utilized the dot probe task to study individuals with BPD did so in a population of female adolescents (von Ceumern-Lindenstjerna, et al., 2010). In contrast to the healthy adolescent comparison subjects, both the adolescent patients with BPD and the adolescent patients with other psychiatric diagnoses showed an attentional bias for negative emotional stimuli, but no differences were found between the two clinical groups (the BPD group and the other psychiatric diagnoses group). Therefore no group specific bias in BPD has been found, as the group with other psychiatric diagnoses showed a similar negative information bias. A bias has been found using the emotional Stroop task; Sieswerda (2006) found that BPD patients showed hypervigilance for schema-related negative cues. However, there was no comparison to individuals with other psychiatric disorders and the study used a different task and age group than von Ceumern-Lindenstjerna et al. (2010). Thus, the two studies cannot be compared. In addition, the sample in the study by Sieswerda (2006) reported all comorbid diagnosis of the participants and of the sixteen BPD participants, seven had a comorbid mood disorder and ten had a comorbid anxiety disorder. Therefore, there is no clear or concise picture of an attentional bias that is specific to BPD.

Experimental Paradigms

Dot Probe Task. One experimental paradigm that has been used extensively to examine the presence of attentional biases in a variety of populations is the dot probe task developed by Macleod, Matthews, and Tata (1988). Like other detection tasks, it is assumed to provide an index of selective attention based upon the assumption that

people will respond faster to probes that are presented in the area of their visual field they are currently attending to (Harvey, et al., 2004; MacLeod, Matthews, & Tata, 1986). In other words, individuals will respond faster to a probe that is placed in an area on which they are already focusing visually than to a probe that appears in a visual area they are not focusing on.

In each trial of the task, individuals first fix their attention on a fixation cross that is presented in the center of the screen. When the cross disappears, two stimuli appear simultaneously on either side of the screen. The stimuli can be on the top and bottom of the screen or on the left and right. The stimuli can be words or pictures; if pictures are used, they are usually pictures of faces. In this pair of stimuli, one is an emotional stimulus (threatening, sad, etc.) and the other is a neutral stimulus. These stimuli are then replaced by a single probe, which the subject must respond to as quickly as possible. In some studies, the probe is a letter and the participant must press the corresponding letter on a keyboard (e.g. E or F). In others, including the current study, the probe is a dot, and the participant must instead indicate whether the dot is on the left or the right side of the screen. Half of the time this probe is in the same spatial location as the emotional stimulus, while the other half of the time it is placed in the spatial location of the neutral stimulus.

If an individual's attention is drawn to the stimulus that the dot replaced, then their response should be faster than if the dot appeared on the opposite side of the screen. Based on this assumption, attentional bias is calculated by subtracting the amount of time taken to respond to dot probes that appeared in place of the emotional stimuli from probes that appeared in the position previously held by the neutral

stimuli. Scores that indicate faster responses to probes replacing the emotional stimuli (i.e. positive scores) are taken as evidence for an attentional bias to that class of emotional stimuli.(Andrews, et al., 2009; Harvey, et al., 2004; MacLeod, et al., 1986). For example, attentional bias away from threat is inferred if a person responds to probes that replace non-threat stimuli faster than probes that replace threatening stimuli. Because both stimuli are presented simultaneously, the faster response time indicates preferential attention to one cue over the other.

It should be noted, however, that some researchers argue that instead of vigilance for the type of stimuli, this pattern of faster response times represents a difficulty to disengage from stimuli rather than initial attention to stimuli. One hypothesis behind the difficulty to disengage theory is that later stages of information processing than allocating attention are involved in this task. This results in the activation of memories and maladaptive schemas that make it difficult for individuals to disengage from information consistent with these schemas and memories (Mobini & Grant, 2007). Unfortunately, the dot probe task currently does not allow researchers to directly examine which of these theories is correct, although studies using the dot probe that measure attentional bias at multiple points in time are able to investigate this issue to some degree.

There are some methodological issues, specifically issues of timing and stimulus choice, which are thought to affect the results of the task. The duration over which participants are exposed to stimuli may affect whether investigators find evidence of attention allocation. Mogg and Bradley (K. Mogg & Bradley, 2006) found evidence of an initial attention bias at a very short stimulus duration of 100 ms,

which was not found at longer stimulus durations of 200 and 500 ms. This suggests that some information processing may involve rapid initial orienting followed by disengagement at longer durations, and this may explain the lack of evidence for attentional bias in longer durations. However, in two earlier studies also done by Mogg and Bradley (1998; 1997), no significant effect of stimulus duration on attentional bias was found non-clinical anxiety samples (Bradley, Mogg, Falla, & Hamilton, 1998; Mogg, Bradley, De Bono, & Painter, 1997). Also, in a meta-analytic study, the effect sizes for stimulus durations less than 500 ms and longer than 1000 ms were both significant; there was not a significant difference between the two types of stimulus durations in anxious populations (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). This issue of stimulus duration is relevant to differentiating biases in anxiety from those in depression, as evidence suggests that anxiety is associated with earlier information processing biases around 500 ms while depression is found more consistently at durations of 1000 ms (Gotlib, Kasch, et al., 2004).

Another issue, which has been mainly resolved in the literature, is that of using pictures rather than words as stimuli. The original dot probe studies used emotional words for stimuli, but the paradigm now mostly involves pictorial stimuli. Pictorial stimuli, such as emotional facial expressions, are considered to be more naturalistic stimuli because they are more closely related to the sorts of social feedback cues individuals receive outside the lab, and therefore are more ecologically valid (Gotlib, Kasch, et al., 2004). A threatening face is a clear sign of danger and therefore is likely to capture the attention of an anxious individual. Pictorial stimuli

are also considered to be more direct signs or cues of threat and hostility than threat-related words, which are considered indirect symbols for that threat. Mogg, Millar, and Bradley (2000) have argued that one problem with the use of word stimuli in this task is that the emotional valence of a word may be confounded by word frequency effects. For example, negative words will likely have a higher subjective word frequency for individuals with emotional disorders because unlike pictures, where it is improbable that the individual will have seen the exact picture before, words related to their disorders will be very familiar. Therefore, the words used as emotional stimuli are likely to be primed in the non- control participants. In practice, studies on depression using facial expressions rather than verbal stimuli yield more consistent results. However, in a meta-analysis by Bar-Haim et al (2007), no difference in combined effect sizes was found between word and pictorial stimuli, and both produced a significant threat bias in anxious participants.

Emotional Stroop Task. Before the creation of the dot probe task, much of the research on attentional bias was based on the emotional Stroop task, which is still a commonly used method. In the original Stroop task, participants were given two lists of names of colors and instructed to say out loud the color ink in which each word is printed. On one list, the names of the colors and the color ink in which they were printed are the same. In the other list, the colors are inconsistent (e.g. the word "blue" is printed in red ink). Participants took longer to read the words where the color of ink is inconsistent with the meaning of the word; this was explained by participant's selective attention to the content of the word interfering with their response. This task was adapted to into the emotional Stroop task by replacing color words with

emotional and non-emotional words (Harvey, et al., 2004). Participants name the colors the words are written in while trying to ignore the content of the words; delays in color naming are seen to occur because the meaning of the word captures the participant's attention.

Many researchers believe that the emotional Stroop task introduces higher order cognitive processes, such as cognitive control, and that it is therefore not a pure measure of attentional bias. While creators and proponents of the task claim that attentional bias is evidenced by slower naming of the color for emotional words compared to non-emotional words (Andrews, et al., 2009; Egloff & Hock, 2003), others call this an index of the need for cognitive control when performing the Stroop. Cognitive control is the ability of our cognitive systems to accomplish specific tasks by guiding adjustments to perceptual selection or maintaining contextual information on-line (Botvinick, Carter, Braver, Barch, & Cohen, 2001). Cognitive control has frequently been operationalized in research as the providing of top-down support for processes relevant to the current task. For example, if a task has high attentional demands then an individual would need cognitive control to arrange a processing bias in favor of task-relevant stimuli so that they would perform the task successfully. (MacDonald III, Cohen, Stenger, & Carter, 2000). Therefore, slow naming of emotional words might represent poor cognitive control abilities. Overcoming habitual responses and correcting errors are tasks that require a high degree of cognitive control and these are cognitive processes that are required to complete the Stroop task.

In addition, it is not clear that the effect seen in the task is a result of selective attention to those emotional words, as there are other explanations for the longer word naming (Harvey, et al., 2004). The non-neutral words may create an emotional reaction that inhibits responses for a time and so causes longer reaction times. Some researchers have criticized the task for confounding stimulus factors with response factors because the length of the emotional word may affect the response time (Gotlib, Kasch, et al., 2004; MacLeod, et al., 1986). Another explanation is that the effect is one of "cognitive avoidance" where the latencies in color naming are due to effortful attempts to suppress the emotional meaning of the word, which are processing resource heavy and therefore might generate the longer response times seen in the task. The negative information contained in some emotional words may interfere with the participant's ability to complete the task despite being extraneous but this interference may be involve a later cognitive process that is unrelated to attention (Bar-Haim, et al., 2007). Therefore, some researchers now consider the emotional Stroop task to be an attention-interference task rather than a selective attention task (Gotlib, Kasch, et al., 2004).

Task Comparison. Gotlib, Kasch, et al. (2004) found that positive and negative bias scores on the emotional Stroop task are positively correlated, suggesting that both positive and negative emotional words can interfere with color naming. This most likely occurs through activation of negative antonyms of the positive words during the semantic processing of the words. The pictorial dot probe task is not susceptible to this unintentional activation because it does not involve semantic processing, whereas there is no pictorial version of the emotional Stroop task.

Another advantage of the dot probe task is that participants make a neutral response to a neutral stimulus (the dot probe) and so longer response times are not as subject to response bias (Bar-Haim, et al., 2007; MacLeod, et al., 1986). Thus, the dot probe task appears to be a more naturalistic and pure measure of attentional allocation (Gotlib, Kasch, et al., 2004). For these reasons, this paradigm was chosen for the present study.

Although much work has been done using the emotional Stroop task, and could be combined with work using the dot probe to provide evidence for disorder specific attentional biases, direct comparison may be unwise. It is unclear if these two tasks are measuring the same or different aspects of information processing or even if they involve the same cognitive processes. The emotional Stroop task involves processing different attributes of a single stimulus in one spatial location, whereas the dot probe task involves visual orienting operations (Mogg, Bradley, et al., 2000). In a related point, the Stroop task requires the active suppression of a response to one of those attributes; this is not the case in the dot probe task. Additionally, in the dot probe task individuals are free to attend to emotional material, whereas during the Stroop task participants are instructed to ignore the emotional meaning of the words.

Additionally, there is conflicting evidence on the relationship between scores on the two tasks. Mogg et al. (2000) found no significant relationship between the bias scores on a dot probe task using word stimuli and the results from the emotional Stroop task. Conversely, Egloff and Hock (2003) found significant associations between both subliminal and supraliminal versions of the tasks. However, these two studies differed on procedural variables, which are especially important in comparing

a study with these research questions, as Egloff and Hock (2003) used a mask version of the dot probe task. Due to the potential problems with the emotional Stroop task and with comparing results from the two experimental paradigms, more research into the effects of psychopathology on attention is needed.

Dot Probe Literature

In the original dot probe study by MacLeod, Matthews, and Tata (1986), clinically anxious and depressed subjects with generalized anxiety disorder were compared to normal controls and each disordered group was compared to the other. The authors found an attentional bias towards threatening stimuli in the anxious group but not in the depressive or normal control group. This was the first evidence from the dot probe paradigm that currently anxious individuals are characterized by attentional biases to threatening stimuli. Dot probe studies that followed replicated these findings and investigated anxiety and attentional bias specifically. Many of these used non-clinical anxious populations and measures of state and trait anxiety. Attentional bias towards threatening stimuli was found in individuals with high trait anxiety regardless of a low or high state anxiety situation (Broadbent & Broadbent, 1988; MacLeod & Matthews, 1988).

Anxiety. In more recent years the dot probe has been used to examine a variety of pathologies. Some evidence for attentional bias has been found using the dot probe task in a variety of disorders that are broadly classified as anxiety disorders including Obsessive-Compulsive disorder, Posttraumatic Stress Disorder, Generalized Anxiety Disorder, Social Phobia and Panic Disorder (Mobini & Grant, 2007). Attentional

biases have been found in each of these various clinical anxiety disorders, and thus it is now accepted by most researchers that anxiety is characterized by a bias towards threat-related stimuli (Mogg, Millar, & Bradley, 2000). However, there are some instances of researchers finding evidence of attentional bias in a disorder while others do not, such as in research using the dot probe task to examine biases in Obsessive-compulsive disorder (Harkness, Harris, Jones, & Vaccaro, 2009; Tata, Leibowitz, Prunty, Cameron, & Pickering, 1996) and Generalized Anxiety Disorder (Bradley, Mogg, Groom, & de Bono, 1999; Gotlib, Krasnoperova, Yue, & Joormann, 2004). Thus, despite acceptance that attentional biases characterize anxiety disorders, studies on different DSM-IV classified anxiety disorders do not provide an entirely clear picture of the nature of these biases (Bar-Haim, et al., 2007).

Depression. In contrast to the significant number of findings on attentional bias in anxiety disorders, research using the dot probe task to examine clinical depression is more limited, and has a mixed pattern of results. Of the small number of dot probe studies on the topic, only a minority have found evidence for attentional biases in this population (Mogg & Bradley, 2005). Two studies that found evidence for attentional bias both used words as stimuli, but differed in their stimulus duration. Mogg, Bradley, and Williams (1995) found a bias for generally negative words at a long duration of 1000 ms, while Matthews, Ridgeway, and Williams (1996) found evidence for a bias towards social threat words displayed for a shorter duration of 500 ms. In a more recent study, an attentional bias towards depression-relevant (i.e. sad) faces was found in depressed participants using a 1000 ms duration (Gotlib, Krasnoperova, et al., 2004). In a study by Fritzsche at al. (2010), attentional bias for

sad faces was found in participants with major depression using a 1000 ms presentation time.

However, several other studies have failed to find evidence for depression-specific biases in clinically depressed adults or adolescents (MacLeod, et al., 1986; Mogg & Bradley, 2005; Mogg, Millar, et al., 2000; Neshat-Doost, Moradi, Taghavi, Yule, & Dalgleish, 2000). These studies suggest that an attentional bias for negative, depression-relevant stimuli may exist but that it occurs in situations where longer stimulus durations allow elaborative processing and thus this attentional bias won't be found at stimulus durations of 500 ms or less. Matthews et al. (1996) found an attentional bias in a depressive group towards social threat words with a shorter duration (500 ms). This could be seen as a contradictory finding which challenges both the presence of a bias only towards depression-relevant material, rather than generally negative material, and the presence of this bias at longer stimulus durations. However, if the participants in the study had significant comorbid anxiety this might explain the presence of a bias to threatening information as well as finding the bias with short stimulus duration.

Borderline Personality Disorder. There is a very small and recent body of work investigating the possibility of attentional biases specific to BPD. In a study using the emotional Stroop task, BPD patients showed hypervigilance towards schema-related negative cues. Predictors of the bias were BPD related schemas, childhood sexual traumas, and BPD anxiety symptoms (Sieswerda, et al., 2007). Wingenfeld et al. (Wingenfeld, et al., 2009) found that BPD patients showed greater interference on the emotional Stroop task only for words related to personal negative

life events. The one available dot probe study on BPD and attentional bias used female adolescents and adolescents with other psychiatric disorders as participants (von Ceumern-Lindenstjerna, et al., 2010). While both the BPD group and adolescents with other psychiatric disorders group showed a bias towards negative emotional stimuli compared to the normal control group, there was no difference between the two groups suggesting that BPD is not characterized by a specific bias.

Unresolved Issues in the Current Literature

Individual Differences. Although the dot probe task appears to be a valuable task for investigating the presence of attentional biases in psychopathology in general, there are some problems with, and gaps in, the current literature. Most of the clinical work done with the dot probe task has compared one sample to another using categorical analysis; they very rarely have looked at any individual measures. Because of the categorical nature, the research may suffer from a lack of statistical power and requires a very large sample size to reach a good effect size (Mather & Carstensen, 2003). Therefore, it has been difficult to examine disorders that occur less frequently in the general population or disorders in which individuals with the disorder are less likely to participate in experimental studies or seek treatment. In the nonclinical work, comparisons are usually done between normal controls and nonclinical individuals who have anxiety or depression scores on the higher side of the sample's range. Because of this, researchers often have control groups that vary less on anxiety scores than the control groups used in clinical research and anxiety scores. Therefore, the control groups used in non-clinical studies may not be

comparable to those in clinical studies and may not be representative of the general population (Bar-Haim et al., 2007). Examining these pathologies from a dimensional perspective using individual measures as this study aims to do will avoid these potential problems.

Comorbid Pathology. This study aims to expand upon the small amount of research that has investigated the potential impact of diagnostic comorbidity on attentional bias findings. In contrast to the large number of studies examining group specific biases, relatively few studies have tried to parse out the effects of certain pathologies that tend to co-occur (Hankin et al., 2010). Few studies examining clinically depressed participants have used samples that did not also have comorbid anxiety disorders (Gotlib et al., 2004). Because of this, it is not surprising that some studies comparing clinically depressed and anxious participants did not find differences in performance on the dot probe task. In the one study that utilized carefully delineated diagnosis to select depressive participants without co-morbid GAD, the depressed group was compared to individuals with GAD and no comorbid depression and to a normal control group (Gotlib et al., 2004). This allowed the study to properly examine the issue of diagnostic specificity and the presence of an attentional bias in pure depression. An attentional bias for sad faces was found in the sample of carefully diagnosed depressives, suggesting that some of the null findings by other researchers can be explained by problems of comorbidity in their samples. This lack of research that controls for or examines the impact of diagnostic comorbidity exists despite the overwhelming evidence that anxiety disorders,

depression, and borderline personality disorder are disorders that exhibit co-occurrence very frequently in clinical populations.

Major depression is often associated with other comorbid lifetime psychiatric conditions, particularly anxiety disorders. Anxiety symptoms are also a common feature of major depressive episodes, even in individuals who do not also have a diagnosis of an anxiety disorder (Fava, et al., 2000). In a recent study conducted in the Netherlands, 60% of the subjects with major depression had an anxiety disorder diagnosis in the last 6-months and 71% had a life-time anxiety disorder.(Van Oppen, et al., 2007). Although some researchers investigating depression acknowledge the problems with comorbidity and have excluded participants with current or lifetime anxiety disorders from their studies (Gotlib, Kasch, et al., 2004; Joormann & Gotlib, 2007), others have either not controlled for comorbidity in this way (Bradley, et al., 1999; Mogg, Millar, et al., 2000; Tata, et al., 1996) or simply did not report this information (Mogg, Matthews, & Eysenck, 1992). Even if researchers exclude individuals with both a DSM-IV based clinically diagnosed depressive and anxiety disorder, it is still possible for the groups to exhibit high scores on self-report measures of anxiety and depression if such measures were used (Chen, Ehlers, Clark, & Mansell, 2002; Karin Mogg, Philippot, & Bradley, 2004).

This diagnostic comorbidity is an important consideration as one possible explanation put forward for the attentional biases sometimes seen in individuals with depression is that they are a function of elevated anxiety levels (Mathews & MacLeod, 2005; Mobini & Grant, 2007) and that studies which do not find attentional biases are those with samples without similar elevated anxiety. There is, however,

some evidence that comorbidity is not responsible for the attentional bias results seen in anxiety. In a meta-analysis of attentional bias studies on anxiety disorders, Bar-Haim et al. (2007) found that the combined effect sizes for studies that excluded mood disorders and studies which did not so were not significantly different. This suggests that the co-occurrence of mood disorders with anxiety does not playing a major role in the attentional biases found in anxiety disorders. However, the impact of anxiety on attentional bias in depression has not been examined.

As discussed previously, anxiety has been found to be associated with the presence of BPD. In a study examining patterns of comorbidity of DSM-III anxiety disorders and personality disorders, borderline personality disorder had a significant rate of co-occurrence with panic disorders and the combined group of any anxiety disorder. Panic disorder and BPD are more than eight times more likely to occur together than separately (Skodol, et al., 1995). Individuals with BPD also frequently have additional current diagnoses of social phobia, specific phobia, OCD, and PTSD (Zimmerman & Mattia, 1999). A study using the emotional Stroop task found increased attentional bias for personally relevant negative stimuli in individuals with both BPD and PTSD in comparison but no attentional bias for individuals with only BPD (Wingenfeld, et al., 2009). This suggests that in addition to further research into biases in the borderline population, future research should investigate the presence of comorbid anxiety disorders in the BPD samples studied and differentiate between the impact these different pathologies are separately having on attentional bias.

Because individuals with BPD often have multiple diagnoses, it is possible that they also often have comorbid depression diagnoses (Zimmerman & Mattia,

1999). A naturalistic study using data from the Collaborative Longitudinal Personality Disorders Study (CLPS) found that 31.3% of their BPD group had a current diagnosis of Major Depression, and 43.9% had a lifetime mood disorder (Skodol, et al., 1999). In addition, three of the five clinical characteristics used in the study significantly predicted co-occurring BPD. Due to the high prevalence of comorbidity between BPD and depression and BPD and anxiety, research into the result of this comorbidity on attentional bias should be explored.

Current Study

The current study will examine the issue of diagnostic comorbidity and specificity using a dimensional approach rather than the categorical approach used by Gotlib et al. (2004). Although care can be taken to exclude participants with mixed anxiety-depression diagnoses, it is still possible that an anxious group would score highly on measures of self-reported depression or vice versa (Dagleish et al., 2003). Utilizing a dimensional model will avoid this potential issue as well as other issues with categorical work mentioned earlier. This approach will also allow for analysis of the effect of each type of pathology separately on an individual's dot probe task performance.

Utilizing the Personality Assessment Inventory (PAI: Morey & Glutting, 1994), a dimensional measure of psychopathology that consists of multiple clinical scales and subscales, and the dot probe task, this study seeks evidence for certain psychopathology specific attentional biases whose possible existences are supported by previous findings or theories on the mechanistic or neural basis of these disorders.

Hypothesis 1: A positive relationship will exist between attentional bias scores for fearful faces and the Anxiety scale and Anxiety-Physiological subscale.

The cognitive theories discussed previously propose that attentional vigilance for threatening information is implicated in the cause and maintenance of anxiety. There is considerable evidence that such biases exist in individuals with anxiety (Bradley, Mogg, & Millar, 2000). Though previous work has been categorical in nature, the evidence found supports having a similar hypothesis for a study that uses a dimensional approach. It should be noted however that most studies use threatening words or pictures to examine attentional bias in anxious individuals. In this study, both angry and fearful faces were used. It is possible that this study will see a relationship between anxiety symptoms and angry faces because they may be threatening and so this relationship will be examined also. However, the primary hypothesis for this study is that an attentional bias towards fearful faces will be seen in individuals with anxiety because the expression of fear by other individuals is often a signal of danger and these individuals have a heightened fear detection system. Therefore, this study predicts that a relationship will be seen between anxiety symptoms as measured and attentional bias towards fearful faces.

In terms of more specific anxiety symptomology, a relationship between physical anxiety symptoms and attentional bias to fearful faces is expected. It is accepted that one of the root mechanisms of anxiety is conditioned fear, which has been shown to be biologically based in mechanisms involving the amygdala (Davis, 1992). The amygdala has been implicated in such non-conscious fear responses as the startle reflex, an aversive reflex exhibited in response to unexpected and possibly threatening stimuli. Because the amygdala is likely to be involved in responding to

dangers and vigilant to these dangers before individuals are consciously aware of danger, we hypothesize that a more specific relationship with the anxiety-physiological scale may be seen.

Hypothesis 2: A positive relationship will exist between attentional bias scores for sad faces and scores on the Depression scale and Depression-Cognitive subscale.

Evidence exists for the presence of a depression-relevant attentional bias for currently diagnosed clinically depressed groups (Gotlib, Krasnoperova, et al., 2004), formerly depressed individuals who have recovered from a depressive episode (Joormann & Gotlib, 2007), and girls who are the children of depressed mothers and thus are at risk for depression (Joormann, et al., 2007). Finding a relationship between PAI Depression scale scores and attentional bias for sad faces would support these findings, using a dimensional rather than categorical and comparative method as well as using a shorter stimulus duration (500 ms). In addition, a more specific relationship with the Depression-Cognitive subscale is expected as cognitive theories of depression posit that depression is caused or maintained by negative schemas that are triggered by stressful life events. When these schemas and memories are triggered, individuals selectively attend to negative stimuli that are consistent with their cognitive schemas.

Unlike the quick fear detection process hypothesized to be involved in anxiety, the attentional bias in depression is seen to operate by accumulating negative material and by activating negative memories; both of these are based on higher order cognitive processes of memory. According to Bower's Differential Activation theory,

in addition to negative cognitive schemas that are activated by certain situations, there are differences in how individuals interpret all events and stimuli when in a depressed mood due to vigilance for negative material (Teasdale, 1988). Therefore, the crucial factor that determines vulnerability to severe depression is the pattern of thinking which exists and persists once the individual is depressed. The symptoms of depression then are seen as a consequence of patterns of thinking which are characterized by negative views.

Hypothesis 3: A positive relationship will exist between attentional bias scores for angry faces and scores on the Borderline scale, Borderline- Affective Instability subscale, and Borderline-Negative Relationships subscale.

Though no significant behavioral evidence exists for a disorder specific attentional bias in BPD, there is theoretical basis for the hypothesis stated above. One of the nine possible symptoms of BPD, as characterized by the DSM-IV TR, is "affective instability due to a marked reactivity of mood (e.g., intense episodic dysphoria, irritability, or anxiety usually lasting a few hours and only rarely more than a few days)" (American Psychiatric Association [*DSM-IV-TR*], 2000). Individuals with BPD frequently express inappropriate, intense anger and have difficulty controlling this anger. These individuals are sensitive to perceived interpersonal slights, losses, or disappointments and this sensitivity is linked to intense, and reactive emotions. The anger is often elicited when a caregiver or friend is seen as neglectful, uncaring, or abandoning and is therefore related to the problems these individuals have with relationships. This anger, which is a typical reaction to feeling misunderstood or mistreated in their relationships, can lead to acts of

aggression toward the self and others. Because of this symptom profile, it is expected that individuals with BPD would show an attentional bias towards angry faces which may display feelings similar to those they are feeling themselves, or may be due to a sensitivity to any possible negative emotions displayed by caregiver or friend, which would be seen as signs of impending abandonment.

Method

Participants

Forty-seven adults from Middletown and surrounding areas participated in this study. All were females between the ages of 20 and 55 years. An all female sample was recruited to reduce sample heterogeneity. Participants were recruited through advertisements in the Hartford Current, the Hartford and New Haven Advocate, and flyers placed in the central Connecticut area. Initial selection information was provided in a telephone screen that established a history of traumatic experiences, impulsive behavior, or extremes in relationships. Individuals were excluded if they had previously received treatment for schizophrenia, hallucinations, or psychotic thoughts or if they had an incident of unconsciousness that lasted longer than 15 minutes. All participants were tested in the Cognitive Affective Personality Science Lab (CAPS).

Self Report Measures

All participants completed the Personality Assessment Inventory (PAI: Morey & Glutting, 1994). The PAI is a self-report measure of personality and mental disorders that consists of twenty-two non-overlapping scales covering the constructs most relevant to a broad-based assessment of mental disorders: four validity scales, eleven clinical scales, five treatment scales, and two interpersonal scales. Every item is rated on a four-point scale ranging from false or not at all true to very true. The eleven clinical scales assess various pathology constructs and provide dimensional measurements based on a person's life history and are: Somatic complaints, Anxiety, Anxiety-Related disorders, Depression, Mania, Paranoia, Schizophrenia, Borderline features, Antisocial features, Alcohol problems, and Drug problems The scales of interest for this study were Anxiety, Depression, and Borderline features. The questions that make up these scales can be found in Appendix A. The reliability of the PAI as a measure is well established and has been demonstrated in a number of different studies (Morey, 1991). Investigations of the measure's internal consistency have returned median alpha coefficients of .86 for the full scales and using a clinical sample and saw little variability based on race, gender, and age. Test-retest reliability has been measured in a normal sample with a .86 median reliability value for the full clinical scales.

The Anxiety (ANX) scale focuses on phenomenology and signs of anxiety in general and is made up of three subscales that look at these symptoms across different modalities. The Cognitive subscale (Anx-C) assesses cognitive features such as rumination, worry, and concern. The Affective subscale (Anx-A) focuses on the

individual's perception of free-floating anxiety and fear. The Physiological subscale (Anx-P) assesses physical symptoms such as tension and stress. Morey and Glutting (1994) found significant correlations (.73) between the ANX scale and the Trait anxiety measure of the State-Trait Anxiety Inventory (STAI: Spielberger, 1983).

The Depression (DEP) scale focuses on the phenomenology and symptoms of depression and like the ANX scale, has three subscales that assess this across different domains. The Cognitive subscale (Dep-C) focuses on thoughts of personal failure and hopelessness. The Affective (Dep-A) subscale measures anhedonia and sadness. The Physiological subscale (Dep-P) focuses on physical signs of depression such as sleep disturbances, problems with appetite, and reduced drive. The scale demonstrates large correlations with different well-validated and often used measures of depression (Morey & Glutting, 1994), such as the Beck Depression Inventory (BDI; Beck & Steer), the Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960), and the MMPI Depression scale (Caldwell, 1988).

The last scale of interest is the Borderline Features (BOR) scale, with subscales that assess four areas found to be characteristic of borderline personality functioning. The Affective Instability (Bor-A) subscale measures heightened emotional responsiveness and if an individual's mood is unsteady or subject to quick changes. The Identity Problems (Bor-I) subscale assesses uncertainty about major life issues and feelings of emptiness. The Negative Relationships subscale (Bor-N) looks for a history of ambivalent and intense relationships. The Self-harm subscale (Bor-S) assesses the presence of self-damaging impulsivity. This scale has displayed

substantial correlations (.77) with the MMPI Borderline personality disorder scale (Morey & Glutting, 1994).

Materials

A set of 72 faces, 36 female and 36 male, was assembled from three standardized picture sets: The Ekman Pictures of Facial Affect (Ekman & Friesen, 1976), the Karolinska Directed Emotional Faces set (Lundqvist, Flykt, & Öhman, 1998) and the NimStim set [1]. Images were selected based on photo quality, as well as on quality of expression by the actor across all of the emotions of interest in the study. All images were rendered black and white and altered so as to appear from the same set. This required alterations to image size, background color, and face size and for the pictures to be equated in luminance. Pictures were also cropped so that the face filled approximately the same space of the image in all the pictures. As each actor expresses every target facial expression during the task, minor alterations were made using Adobe Photoshop to several of the photographs to make the actors' appearances more consistent across photographs (e.g. consistency of hairstyle). At the end of the modifications, all images were sized to 450 pixels by 300 pixels. Stimuli were presented on a HP L2045 widescreen monitor with 1680x1050 @ 60Hz resolution and dimensions of 57.3 x 30.2 cm using an iMac and Psyscope *X* B53 software.

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[1] Development of the MacArthur Network Face Stimuli Set was overseen by Nim Tottenham and supported by the John D. and Catherine T. MacArthur Foundation Research Network on Early Experience and Brain Development.

Procedure

Each participant completed four experimental runs, with one additional shorter practice run consisting of 8 trials. There were 72 trials in each run, for a total of 288 experimental trials. Each trial began with the presentation of a black fixation cross at the center of the screen for 500ms. This was followed by the presentation of two faces for 500 ms. These face pairs consisted of one emotional and one neutral face presented by the same actor. These pictures were presented side-by-side, and equal distances from where the fixation-cross had just appeared in the center. Immediately following the termination of the faces, a small black dot appeared on either side of the screen and in the center of the screen location where one of the pictures had just appeared. In the practice trials, the dot remained present until the participant pressed a key indicating on which side of the screen the dot appeared. In the experimental runs, the dot appeared on the screen until the participant responded, or for 1500 ms, whichever occurred first. Psyscope recorded the latency as well as the accuracy of the response but no feedback was given as to inaccurate responses. The intertrial interval was 2000 ms.

	FIXATION	FACES	TEST	INTERTRIAL (BLANK)
SAD (INCONGRUENT)	+		●	
FEAR (CONGRUENT)	+		●	
	500	500	1500	2000

Figure 1. *Diagram of Task*

Participants placed their index fingers on "F" key, which was labeled "L" for left, and the J key, which was labeled "R" for right. Participants were told:

"*In each trial, you will see a plus sign at the center of the screen. Focus your gaze directly at the plus sign. Each time you see it, get ready for the next screen. On the next screen, you will see two photographs of the same person, although their expressions will differ. You should focus on the pictures. Next, the faces will disappear and a dot will appear on either right side or left side of the screen. Your task is to press the button corresponding to the side of the screen on which the dot appears. Do this as quickly as you can without sacrificing accuracy.*"

Each participant received a different presentation order of the four sets, which consisted of the same stimulus set of 72 face pairs in a different order. Therefore, each participant saw each face pair four times. Actors were shuffled from set to set so that they appeared in a different quartile in the four sets. To control for effects that might be specific to certain actors, the emotion that an actor expressed varied so that an actor expressed a different emotion in each set. For example, an actor who expressed an Angry face in set 1 expressed a Sad face in set 2, a Happy face in set 3, and a Fearful face in set 4.

Emotion type, gender of the actor, side the emotional face appears on, and side the dot probe appears on, were evenly distributed across the quartiles of each run list. There were four possible combinations of the location of the dot probe, the emotional picture, and their relation to each other: (1) Emotional picture on the left/dot on the left (2) Emotional picture on left/dot on right (3) Emotional picture on right/dot on right (4) Emotional picture on right/ dot on left. The first and third

conditions are congruent conditions, as the picture and the dot occupy the same space in the visual field. The second and fourth conditions are incongruent conditions because the dot appears on the other side of the screen. Within the runs, trials were counterbalanced so that no combination followed another type more than once. In addition, each actor appeared in each of these positions across the sets.

Individuals also completed a questionnaire after the task that assessed their impression of the difficulty of the task, and if they felt they had used any strategies. This post-questionnaire was given to provide information that might help explain any oddities in individual data.

Results

Participant Characteristics

Participants' mean age was 33.06 (*SD* = 10), and the group identified predominantly as Caucasian and as not Hispanic. Mean scores on the PAI scales and subscales of interest are given in Table 1. As expected, the mean scores on the PAI scales are higher than the mean observed in the normal community populations measured while validating the scale (Morey, 1991), which supports classification as a clinical population. However, the percentage of participants reporting scores above the clinical cut point is low for all of the scales, with 40% of participants on the anxiety scale, 38% on the depression scale, and 44% on the borderline scale reaching or exceeding the clinical score of 70.

In addition, there was a roughly normal distribution of scores instead of the pattern of infrequent higher scores that one would expect in a normal sample. While Morey's community samples displayed a positive skewness for all three scales, the current sample had a slight negative skewness for the Anxiety (*sk* = -.087) and Borderline scales (*sk* = -.193) indicating that, as expected, a greater number of values lay to the right than the left of the mean. In other words, participants reported scores on the PAI that were skewed in a pathological direction.

Table 1. *Mean PAI scores*

	PAI	
Scale	*M*	*SD*
Anxiety	64.06	14.6
Anx- Affective	62.64	13.59
Anx- Cognitive	62.21	14.7
Anx- Physiological	63.38	14.24
Depression	63.62	15.84
Dep-Affective	63.72	16.42
Dep- Cognitive	57.98	15.75
Dep- Physiological	62.11	12.1
Borderline features	66.42	15.01
Bor- Affective Instability	63.77	15.4
Bor- Identity Problems	62.98	13.88
Bor- Negative Relationships	66.77	15.23
Bor- Self-harm	58.36	15.1

The relationship between age and scores on the PAI scales and subscales was investigated to see if older individuals tended to have higher or lower scores than younger participants. The correlation was not significant, and so age was not used as a covariate in any analysis.

Participants' scores on all three PAI scales of interest were significantly correlated with one another. Anxiety was significantly correlated with Depression, $r(45) = .797$, $p < .001$, and Borderline Features, $r(45) = .798$, $p < .001$. Depression and Borderline Features were also significantly correlated with each other, $r(45) = .841$, $p < .001$. Participant's scores on the subscales of interest were all significantly correlated with one another ($p < .001$) except for Borderline Features- Self Harm which was only significantly correlated with Depression-Cognitive and Borderline Features- Affective Instability, ($p < .05$). See Table 2 below.

Table 2. *Pearson Correlations between PAI Subscales*

	Anx-A	**Anx-C**	**Anx-P**	**Dep-A**	**Dep-C**	**Dep-P**	**Bor-A**	**Bor-I**	**Bor-N**
Anx-A									
Anx-C	.802**								
	.000								
Anx-P	.797**	.795**							
	.000	.000							
Dep-A	.698**	.765**	.666**						
	.000	.000	.000						
Dep-C	.674**	.658**	.616**	.785**					
	.000	.000	.000	.000					
Dep-P	.701**	.678**	.547**	.767**	.637**				
	.000	.000	.000	.000	.000				
Bor-A	.665**	.694**	.702**	.792**	.623**	.730**			
	.000	.000	.000	.000	.000	.000			
Bor- I	.733**	.780**	.750**	.803**	.823**	.599**	.710**		
	.000	.000	.000	.000	.000	.000	.000		
Bor-N	.709**	.763**	.689**	.764**	.749**	.663**	.753**	.779**	
	.000	.000	.000	.000	.000	.000	.000	.000	
Bor-S	.105	.106	.269	.175	.300*	.199	.429**	.244	.215
	0.482	.478	.067	.239	.041	.180	.003	.099	.146

Notes: Upper numbers represent *r* values from Pearson correlations
Lower number represent *p* values. ** p < 0.01 (2-tailed). * p < 0.05 (2-tailed).

Attentional Bias Scores

Data from trials with errors or invalid responses were discarded. Error and invalid response rates were very low (.11%). To minimize the influence of outlier responses, reaction times that were less than 100 ms were removed because they are considered anticipation errors. Responses more than three standard deviations above each participant's mean were also excluded. This resulted in the deletion of only 0.16% of the total trials. Analyses were than conducted using the remaining data.

Mean response times for the two different conditions (congruent vs. incongruent) were calculated for each of the four emotional faces and are presented in Table 3. These average reaction times were used to compute attentional bias scores for use in specific analyses.

Table 3. *Mean Reactions times (in milliseconds)*

Emotion Face/Probe location	
Angry	
Congruent	417 (60)
Incongruent	423 (60)
Fearful	
Congruent	418 (61)
Incongruent	424 (60)
Happy	
Congruent	419 (54)
Incongruent	422 (60)
Sad	
Congruent	414 (59)
Incongruent	419 (59)

Note. Standard deviations are shown in parentheses. Congruent = probe in same location as emotional face. Incongruent = probe in different location than emotional face

To summarize the attentional bias, attentional bias scores were calculated for every facial expression for each participant. This was done by using the mean

reaction times calculated for each participant previously in the equation shown in Figure 2 below, which has been modified from the original MacLeod and Matthews study (1986) for stimuli presentations done side by side rather than above and below each other.

Figure 2. Equation for attentional bias

Attentional bias score = ½ [(RpLe-RpRe) + (LpRe-LpLe)]	
R	Right position
L	Left Position
p	Probe
e	Emotional face

Therefore, RpLe in the equation corresponds to the mean reaction time when the dot probe appears on the right side and the emotional face is on the left. In other words, it represents the incongruent condition as it occurs when the emotional face is on the left (Gotlib, Krasnoperova, et al., 2004). This equation subtracts the response time when the emotion and probe are incongruent from the response time when they are congruent. The equation also accounts for differences in the side the probe appears on which is important as most studies on the dot probe find participants are generally faster to respond to probes on the right than on the left, something that may be due to most participants being right handed (Bradley, et al., 1997). Positive values on this score indicate a shift of attention toward the spatial location where the emotional faces appeared relative to where the neutral face in the pair was located. Negative values indicate attention shifted away from locations of emotional faces relative to neutral faces.

Participant's attentional bias scores for one face type were not significantly correlated ($p > .05$) with their attentional bias scores for any other face type, suggesting that there is some specificity for the emotion of bias.

Attentional Bias and the PAI

Correlation analysis were run between participant's attentional bias scores and their scores on the PAI scales and subscales of interest to investigate the specific hypotheses of this study. Analysis of the PAI scales and attentional bias scores reveled no significant correlations, while significant correlations were found using the PAI subscales for correlation analysis.

Hypothesis 1: A positive relationship will exist between attentional bias scores for fearful faces and the Anxiety scale and Anxiety-Physiological subscale.

The relationship between the Anxiety scale and attentional bias scores for fearful faces was not significant; however, the negative relationship between these two scores was at trend level ($p = .06$). Participants' attentional bias scores for fearful faces were significantly negatively correlated with the Anxiety-Physiological subscale, $r(45) = -.331$, $p < .05$. Correlations were also run on scales and subscales outside of the specific hypotheses. The relationship between fearful attentional bias scores and the Anxiety-Affective, $r(45) = -.253$, $p = .086$, and Borderline Features-Self Harm, $r(45) = .245$, $p = .097$, subscales approached significance.

Hypothesis 2: A positive relationship will exist between attentional bias scores for sad faces and scores on the Depression scale and Depression-Cognitive subscale.

The correlation between attentional bias scores for sad faces and the Depression scale of the PAI was not significant, $r(45) = .192$, $p > .05$. Attentional bias scores for sad faces were significantly correlated with Depression-Cognitive, $r(45) = .336$, $p < .05$, as hypothesized. Beyond specific hypotheses, the Borderline Features- Identity Problems subscale was also significantly correlated with attentional bias for sad faces, $r(45) = .321$, $p < .05$. The positive relationship between Sad attentional bias scores and Borderline Features- Negative relationships subscale was at a trend level, $r(45) = .246$, $p = .095$.

Hypothesis 3: A positive relationship will exist between attentional bias scores for angry faces and scores on the Borderline scale, Borderline- Affective Instability subscale, and Borderline-Negative Relationships subscale.

The hypothesis that there would be a relationship between the Borderline scale and angry attentional bias scores was not supported, $r(45) = .011$, $p > .05$. Also, the relationship between angry attentional bias scores and the two borderline subscales of Affective Instability, $r(45) = .005$ and Negative Relationships, $r(45) = -.182$, were both not significant, $p > .05$.

Discussion

Comorbidity in Sample

The finding that the scores on the three PAI scales and ten subscales of interest were all strongly correlated was expected, as these three areas of psychopathology co-occur frequently. The strong relationship is seen in our sample reflects the patterns of co-occurrence seen in clinical populations. As discussed previously, individuals with BPD frequently have additional current diagnoses of many different anxiety disorders (including social phobia, specific phobia, OCD, and PTSD), and because these individuals frequently have multiple disorders, it is possible that they also often have comorbid depression diagnoses (Zimmerman & Mattia, 1999). Anxiety and depression themselves are often co-occurring and diagnosed or treated concurrently in an individual. Therefore, the strong relationship between the two psychopathologies suggests that our sample accurately represents the comorbidity seen in the clinical population as well as reflects the theoretical connections between these psychopathologies.

Psychopathology and Attentional Bias Scores

Scores on the overall PAI scales of interest and performance on the dot probe task showed no pattern of relationship. Examination of the subscales and their relationship to attentional bias scores, however, revealed three significant correlations. This suggests that using more discrete parts of psychopathology in this area of research may provide evidence for a relationship to attentional bias in research

where no relationship is seen with a general, higher-level pathology. Therefore, investigations using components of psychopathology may provide a clearer relationship to attentional mechanisms and more research should be done which uses dimensional approaches and focus on specific components of psychopathology. In addition, finding more specificity in attentional bias when using subscales rather than scales suggests a possible explanation for the mixed results seen in the attentional bias literature. Research that does not base samples on these more specific parts of psychopathology, such as physiological or cognitive aspects, may be more likely to differ on findings because the samples used in different studies may not be similar on these aspects.

In terms of specific findings, a negative relationship was found between scores on the anxiety-physiological subscale and attentional bias scores for fearful faces. Individuals with more physiologically based anxiety symptoms showed an attentional bias away from fearful faces. This suggests that individuals with anxiety involving physiological facets tend to avoid fearful stimuli. Theoretically this may imply a difference between fearful anxiety, which is related to avoidance of threat, and ruminative anxiety, which is related to a bias towards threatening information.

A positive relationship at the trend level was found between scores on the anxiety-affective subscale and attentional bias towards fearful faces. This relationship mimics the frequent finding that anxiety involves an attentional bias towards threatening stimuli. In contrast, the relationship with physiological facets of anxiety shows an attentional bias in an opposite direction to that frequently observed in the literature, namely a bias away from fearful faces. This may explain the fact that

though frequent, an anxiety specific bias is not found in every study. In studies that only employ categorical analyses that compare the anxious group with a control group, an anxious group with individuals whose anxiety is primarily composed of physiological symptoms as well as individuals whose anxiety is primarily affective might see a net neutral attentional bias in the anxiety group as a whole. If this is the case, it is possible that no difference would be seen between the anxious and control groups in these studies.

A relationship was found between scores on the depression-cognitive subscale and attentional bias scores for sad faces, which suggests that individuals with more cognitively based depression symptoms showed more attentional bias towards sad faces. This is in agreement with cognitive theories of depression discussed previously as well as with the idea that individuals with depression may be accumulating depression-congruent material. However, as depression is more reliably seen in longer stimulus durations than those used in this study, it is important to see if this finding stands when stimulus duration of 1000 ms is used.

A relationship was also found between scores on the borderline-identity problems subscale and attentional bias for sad faces. In addition, trend level correlations between scores on the borderline-self harm subscale and attentional biases for fearful faces and the borderline-negative relationships subscale with attentional biases for sad faces were also found. This may reflect the fact that BPD is a very heterogeneous disorder encompassing many different types of symptoms. Therefore, any sample is likely to include people who present symptoms in many different ways, causing the lack of specificity in the relationships seen in this study.

This heterogeneity within a single disorder is one weakness of the categorical diagnostic system used in the DSM-IV. Because diagnosis, and thus placement into a category, is based on having a certain number of symptoms that come from a much larger list, patients classified with one disorder can exhibit widely different symptoms (Sanislow, et al., 2010). This is true for the borderline personality construct, as diagnosis with this disorder is based upon exhibiting five or more symptoms from a set of nine symptoms (*DSM-IV-TR*, 2000). One benefit of elucidating attentional biases is that they might provide a construct that is closer to the underlying psychopathology than the symptom clusters currently used. Intermediate cognitive functions such as attention, although not clinical symptoms themselves, may help researchers and clinicians to understand the relationship between higher order behaviors and causal mechanisms such as hormones, neural circuits, and molecular pathways without needing to explain the heterogeneity present in disorder constructs.(Sanislow, et al., 2010). For example, although the array of possible symptoms can make it difficult to see a clear picture of what the borderline personality disorder construct entails, an individual's attentional bias as measured by a behavioral task is a discrete and clear difference in cognitive function.

Unreliability as an Alternative Explanation

The dot probe task has been criticized and called an unreliable task because of findings of poor reliability estimates (Staugaard, 2009). The unreliability of the task has been posited as an explanation of the lack of consistency in the literature. Schmukle (2005) published estimates of internal consistency and retest reliability,

using a non-clinical sample, as evidence for the unreliability of the task. Internal consistency was estimate by computing split-half reliability and by using Cronbach's α to examine bias scores. Correlations between the first and second half of the task were not significant, suggesting no relationship between the scores in different halves of the task. To investigate retest reliability, the task was run on the same participants two different times in a one-week interval. Correlations between bias scores at these two different testing instances were not significant, except for the physical threat words. Schmukle (2005) took these results as evidence that the dot probe task is not internally consistent or stable, and that the task measures only error variance, which explains the lack of replicable and substantial effects. It should be noted however, that this research did not use photographs of human facial expressions as stimuli. Staugaard (2009) replicated Schmukle's (2005) findings using the pictorial version of the task, but again used a non-clinical population and measures of individual differences. It is also possible that this task is one in which individuals become acclimated to the stimuli and therefore performance on the task a second time is different from performance the first time.

Both Schmukle and Staugaard recommend that any results from the dot probe regarding individual differences should be interpreted with caution, as it appears that the task is insensitive to detecting interindividual differences but that the task may still be useful in between-group designs comparing clinical and nonclinical groups. Unfortunately, examining issues of comorbidity and specificity of psychopathology as possible explanations for the variability seen in the results, as done in this study, does not explain issues addresses by Schmukle (2005) or Staugaard (2009). The

current study does not examine the same individuals at different time points and so cannot address issues of test-retest reliability; nor was it intended to. It is important to note however, that these studies were done using nonclinical populations and so may not be relevant to research using the dot probe in clinical populations. Therefore, a study using clinical populations to examine internal consistency and reliability should be done to examine if these are problems with the task that are contributing to the differences seen in the clinical literature.

Limitations

Sample. All participants for this study were female which does limit generalizability. This was done, however, for two reasons. Foremost to the goals of the study, there exists a large amount of heterogeneity in these clinical populations. Interactions of symptomology with gender, education, and age of onset inflate this heterogeneity and some leading psychopathology researchers have advocated the strategy of focusing on a single gender as a starting point for decreasing sample heterogeneity (Maher, 2002). Thus, this study used a single gender sample with the goal of reducing heterogeneity. The choice of studying females over males as a starting point was made because BPD has been found to be more common in women than men in clinical samples. For instance, studies report findings of female prevalence from 70 to 76 percent of borderline patients (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004; Widiger & Weissman, 1991). As a consequence, a majority of the literature on BPD focuses on its occurrence in women (Johnson, et al., 2003), and so using a female sample facilitates comparison with past work on BPD. Though

there were reasons for the choice of this sample, however, it is acknowledged that these phenomena should be studied in male and both gender populations for purposes of comparisons and to expand generalizability.

Timing. It is important to note that these findings come from a task that used a 500 ms stimulus presentation. There are multiple strengths that come from using this duration, including the fact that it is the duration used in most dot probe task studies and therefore the use of this duration allows for comparison with most other studies. Also, this is the stimulus duration at which attentional biases have been most reliably found in anxious groups. As this study did involve anxious psychopathology, it is important to use this shorter duration. It also allowed us to examine the relationship between depression and attentional bias for sad faces using a stimulus duration that was shorter than 1000 ms, something that has not been done frequently as theories point towards attentional bias in later stages of processing and therefore at longer stimulus durations.

Current theories about the workings of human cognition illustrate further advantages of this duration. This duration is advantageous because it limits the engagement of higher order processes and so allows us to control for the level of cognitive processing that the attentional bias is affecting. The short duration does not allow other cognitive processes to effect interpretation, and as one of the advantages of the dot probe task over the emotional Stroop task this was important to maintain. For example, longer stimulus durations may allow for multiple attentional shifts before the dot probe is presented, which makes the picture of attentional bias muddy. Longer durations also likely incorporate levels of information processing further

along in cognition than the type of immediate processing seen in the short 500 ms duration. In incorporating deeper levels of information processing, different brain areas and structures may be activated. For example, the anterior cingulate cortex has been shown to engage when responding to incongruent stimuli in the emotional Stroop task (MacDonald, Cohen, Stenger, & Carter, 2000). If the emotional Stroop task employs more complex levels of processing, as is commonly accepted, then longer durations in the dot probe task may also activate this structure. Similarly, it is possible that the orbitofrontal cortex (OFC), which has been shown to be involved in representation of emotional stimuli as well as assignment of valance and salience of emotional stimuli, may be differentially engaged later on in emotional information processing (Rolls, 2004).

Although using short stimuli durations in the task allows us to better control and limit the structures involved in the task it does limit our understanding of the full picture. The structures mentioned, and many other brain areas, contribute to a person's full perceptual world as well as to their experience of psychopathology, which may affect their views of that world. Therefore, though it was not done in this study, it is important to examine attentional bias at longer duration levels using this same approach. In addition, using eye-tracking equipment to give information about gaze across the duration may yield additional information helpful to building a clear picture of attention.

Attentional Bias Modification Treatment

Understanding the nature of attentional biases in emotional disorders is important because these attentional biases provide a possible and promising new form of cognitively based therapy. Despite the presence of current cognitive, behavioral, and biological treatments available for anxiety, depression and personality disorders like BPD, many individuals continue to suffer from the effects of these disorders (Hakamata, et al., 2010). Therefore, it is worthwhile to continue developing novel treatments with the potential to provide greater relief. Although some treatments provide relief, there are often factors or characteristics of the treatment that make it difficult for individuals to follow through with the course of treatment. For example, many people find cognitive-behavioral based therapies to be too difficult and emotionally demanding and are unable to continue them in a way that might be beneficial. Additionally, patients are often understandably unwilling to take the types of medications available because of the side effects or because little is known about how these medications work.

In general, research into Attention Bias Modification Treatment (ABMT) as a specific type of cognitive bias modification has been motivated by the idea that it could lead to new treatments that work by modifying attentional processes and that are more effective and efficient (Harvey, et al., 2004; Mobini & Grant, 2007). This type of training using involves a modified dot probe task where the dot probe replaces the neutral stimulus 100% of the time instead of varying placement behind the neutral and emotional stimulus as is done in the experimental version of the task. Thus, the individual should learn an intentionally created rule that if an emotional and neutral

stimulus are presented in the environment, they should attend preferentially to the neutral stimuli. The hypothesis is that because attentional biases have a role in the maintenance of anxiety, lowering attentional biases to emotional information should alleviate psychopathology symptoms.

The early work into cognitive bias modification treatments suggests that the attentional biases associated with certain emotional disorders can be reduced using these types of therapies (March, 2010). Colin MacLeod, the researcher responsible for first creating and experimenting with the dot probe task, was also the first to suggest that directly targeting mechanisms which control attention to threat should have an ameliorative effect on attentional biases in individuals with anxiety disorders (MacLeod, 1995). The research that has followed this hypothesis has recently started to expand and has begun to provide some preliminary evidence that this kind of modification training can be effective (Hakamata, et al., 2010). In a recent meta-analysis by Hakamata et al. (2010), twelve studies that investigated the impact of ABMT on anxiety symptoms using the dot probe task were analyzed and a significantly greater reduction of anxiety than in the control training was found, with a medium effect size. A study examining the effects of ABMT on dysphoric students as well as depressed in and out-patients found mild improvement in symptoms for a student group with mild depressive symptoms but no improvement for the patient group (Baert, De Raedt, Schacht, & Koster, 2010). These are only the beginnings of this research however and the procedure still needs optimization, especially in terms of procedural factors such as stimulus durations to be used with different populations

and more research into emotional disorders outside of Generalized Anxiety Disorder or nonclinical populations.

Conclusion

This study provides evidence that use of broad psychopathology constructs, such as DSM-IV disorder diagnosis, may be causing some of the variability seen in the literature. Though research examining the alternative explanation of task unreliability should also be pursued, it appears that the use of subcomponent symptom clusters may help researchers to generate a clearer picture of specific biases. The relationships between more specific components of psychopathology and attentional bias, such as those found in this study, may provide a way to generate more focused treatment groups for ABMT research and therefore possibly greater treatment effects. In addition, with further investigation into the relationship between specific components of psychopathology and attentional bias like that done in this study, attentional bias score variations may provide information about underlying dimensions of psychopathology which could be beneficial for clinical practice and diagnosis.

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Appendix A.

These questions were presented separately and interspersed within questions from other scales. They were also not necessarily presented in this order.

I. ANXIETY
   1. Anxiety- Affective
      - I am so tense in certain situations that I have great difficulty getting by.
      - I can't do some things well because of nervousness.
      - Sometimes I am afraid for no reason.
      - I'm not the kind of person who panics easily.
      - I am a very calm and relaxed person.
      - I often feel as if something terrible is about to happen.
      - I seldom feel anxious or tense.
      - I am easily startled.

   2. Anxiety- Cognitive
      - I often have trouble concentrating because I'm nervous.
      - It's often hard for me to enjoy myself because I am worrying about things.
      - I'm often so worried and nervous that I can barely stand it.
      - My friends say I worry too much.
      - I don't worry about things any more than most people.
      - I don't worry about things that I can't control.
      - I usually worry about things more than I should.
      - Sometimes I get so nervous that I'm afraid I'm going to die.

   3. Anxiety- Physiological
      - I often feel jittery.
      - I worry so much that at times I feel like I am going to faint.
      - Sometimes I feel dizzy when I've been under a lot of pressure.
      - I can often feel my heart pounding.
      - It's easy for me to relax.
      - When I'm under a lot of pressure, I sometimes have trouble breathing.
      - I get sweaty hands often.
      - I have very steady hands.

II. DEPRESSION
   1. Depression-Affective
      - Lately I've been happy much of the time.
      - Everything seems like a big effort.
      - I'm almost always a happy and positive person.
      - I have no interest in life.
      - Much of the time I'm sad for no real reason.
      - Nothing seems to give me much pleasure.

- I've lost interest in things I used to enjoy.
- I've forgotten what it's like to feel happy.

2. Depression- Cognitive
   - Sometimes I think I'm worthless.
   - I have something worthwhile to contribute.
   - No matter what I do, nothing works.
   - I don't feel like trying anymore.
   - I think good things will happen to me in the future.
   - I feel that I've let everyone down.
   - I can't seem to concentrate very well.
   - I'm pretty successful at what I do.

3. Depression- Physiological
   - I have a good appetite.
   - I hardly have any energy.
   - I often wake up in the middle of the night.
   - I rarely have trouble sleeping.
   - I often wake up very early in the morning and can't get back to sleep.
   - I have no trouble falling asleep.
   - I've been moving more slowly than usual.
   - I have little interest in sex.

III. BORDERLINE
1. Borderline- Affective Instability
   - My moods get quite intense.
   - I've had times when I was so mad I couldn't do enough to express all my anger.
   - My mood can shift quite suddenly.
   - I've always been a pretty happy person.
   - My mood is very steady.
   - I have little control over my anger.

2. Borderline- Identity Problems
   - I often wonder what I should do with my life.
   - My attitude about myself changes a lot.
   - Sometimes I feel terribly empty inside.
   - I worry a lot about other people leaving me.
   - I can't handle separation from those close to me very well.
   - I don't get bored very easily.

3. Borderline- Negative Relationships
   - People once close to me have let me down.
   - My relationships have been stormy.
   - Once someone is my friend, we stay friends.
   - I've made some real mistakes in the people I've picked as friends.

- I rarely feel very lonely.
- I want to let certain people know how much they hurt me.

4. Borderline- Self-harm
    - I'm a reckless person.
    - I spend money too easily.
    - I sometimes do things so impulsively that I get into trouble.
    - I'm too impulsive for my own good.
    - When I'm upset, I typically do something to hurt myself.
    - I'm careful about how I spend my money.