Processing of Emotional Information in Major Depressive Disorder: Toward a Dimensional Understanding

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Abstract

Several decades of research converge on the formulation that individuals diagnosed with major depressive disorder (MDD) exhibit negative biases in their processing of emotional information. It is becoming increasingly clear, however, that traditional between-group comparisons have obscured the substantial heterogeneity of cognitive and affective dysfunction that is associated with depressive symptomatology. In this article, we review the findings of research examining attention to and memory for negative emotional information using a more dimensional perspective on depression. Specifically, we explore studies that assess cognitive biases along a continuum of depressive symptom severity and consider the influence of co-occurring dimensions of functioning, in particular the severity of anxiety symptoms. Finally, we identify critical empirical questions and issues in this growing literature.

Keywords
anxiety disorders, attention, comorbidity, depression, dysphoria, memory

Major depressive disorder (MDD) is among the most prevalent, costly, and debilitating of all psychiatric disorders (American Psychiatric Association, 2013). Indeed, MDD is ranked as the single most disabling disease among midlife adults worldwide, and its contribution to the global burden of disease is projected to increase further by the year 2030 (World Health Organization, 2004). It is imperative that we understand the etiology and pathophysiology of depressive illness in order to effectively prevent and treat this disorder.

Cognitive models of depression were developed several decades ago in an attempt to understand MDD, postulating that maladaptive ways of thinking increase risk for developing the disorder (e.g., Beck, 1976). At about the same time, advances in models of information processing began to stimulate a large body of research on cognition and emotion (reviewed in Dykman & Abramson, 1990). Considered collectively, research over the past 40 years has converged on the formulation that individuals diagnosed with MDD exhibit specific biases in their processing of emotional information. In this article we review two such cognitive biases: selective attention to and selective memory for negatively valenced, over neutral or positively valenced, material. Importantly, recent interventions aimed at ameliorating these biases suggest their causal role in the onset and maintenance of depressive symptomatology (see Hallion & Ruscio, 2011, for a meta-analysis).

These insights are important in helping us gain a better understanding of the diagnostic category of MDD. Nevertheless, it is becoming increasingly apparent that traditional comparisons between clinically depressed and nondepressed participants obscure the heterogeneity of functioning that characterizes depressed individuals (Insel, 2013). In addition, the significant comorbidity between depression and other disorders, particularly anxiety disorders, is well established; approximately half of people who are diagnosed with MDD meet criteria for one or more anxiety disorders within the same year (Kessler, Chiu, Demler, Merikangas, & Walters, 2005). The functioning of this substantial proportion of persons with co-occurring depression and anxiety may differ in important ways from that of individuals with MDD alone. Finally, individuals who report elevated levels of depressive symptoms that fall short of the diagnostic...
threshold for MDD may nevertheless exhibit maladaptive patterns of information processing. In fact, the endorsement of sub-syndromal symptoms of depression is a strong predictor of the subsequent onset of MDD (Wolitzky-Taylor et al., 2014). We contend that a dimensional approach to assessing symptom levels and cognitive correlates will be useful in identifying points along the continuum of symptom severity at which various intervention efforts may be warranted in an attempt to mitigate risk for developing full-blown MDD.

Scope of Review and Literature Search Strategy

In this article, we address these issues by exploring an alternative, dimensional, model of negative biases in attention and memory in relation to depressive symptomatology. We focus on attentional and memory biases because many of the experimental paradigms and types of stimuli used to investigate these biases are integrated within or shared across studies, allowing for stronger comparisons and conclusions. Furthermore, attentional and memory processes are emphasized in emerging dimensional approaches to studying psychopathology (i.e., National Institute of Mental Health Research Domain Criteria; http://www.nimh.nih.gov/research-priorities/rdoc/research-domain-criteria-matrix.shtml).

With respect to our literature search strategy and inclusion/exclusion criteria, we examined the available literature with two specific goals. First, we focused on studies of individuals who were experiencing subclinical levels of depressive symptoms that do not meet the threshold for a diagnosis of MDD and of individuals who were characterized along a continuum of levels of depressive symptoms. Second, we included studies that directly investigated these cognitive biases in co-occurring depression and anxiety disorders.

In the final sections of this article, we synthesize the reviewed findings and identify key theoretical and empirical issues that we believe must be addressed in order to develop a viable dimensional model of the processing of emotional information.

Research on Attentional Biases

There is strong empirical evidence that the diagnosis of MDD is associated with selective attention to information representing themes of sadness and loss, a cognitive bias that occurs only at later, elaborative, stages of attention and is not observed in non-depressed individuals (reviewed in Armstrong & Olatunji, 2012; Gotlib & Joormann, 2010; Peckham, McHugh, & Otto, 2010; Wisco, 2009). With respect to dimensionally relevant research, Table 1 summarizes the key features of the empirical studies reviewed in what follows in terms of participant samples, experimental paradigms, stimulus types, and stimulus durations.

Subclinical Depressive Symptoms

Investigators examining the functioning of individuals with subclinical levels of depressive symptoms typically refer to these samples as “dysphoric.” Researchers have generally recruited participants on the basis of elevated scores on self-report measures of depressive symptoms; the specific selection criteria and cutoff scores used vary across studies. In addition, most investigators do not assess or report participants’ diagnostic status; therefore, some participants may have been clinically depressed, resulting in findings that might appear to be more similar to those obtained in studies of MDD than would be the case if all of the participants in these studies had subthreshold levels of symptoms. It is also likely that dysphoric samples are elevated on levels of general distress and symptoms of other disorders. As a final issue to consider, dysphoric samples frequently represent samples of convenience (i.e., undergraduates) and, therefore, likely differ from clinically depressed participants with respect to background and demographic characteristics.

Koster and colleagues (Koster et al., 2005; Koster et al., 2010) used a modified spatial cueing paradigm to isolate components of attention, including attentional orienting, maintenance, and disengagement. In two experiments, Koster et al. (2005) found that dysphoric participants, relative to non-dysphoric participants, exhibited stronger maintained attention to negative words and impaired disengagement from negative words at durations of 1,500 ms, but not at earlier durations. Koster et al. (2010) replicated these findings as a dysphoric group exhibited stronger maintenance of attention to negative words under a condition that allowed for elaborative encoding, but not when elaboration was prevented. Across the experiments, the dysphoric groups reported higher trait anxiety than did the nondysphoric groups; however, the authors did not examine the influence of trait anxiety on the dependent measures.

Eye-tracking studies of dysphoria have supported these findings. For example, Caseras et al. (2007) found that, while viewing negative images, a dysphoric group maintained their gaze longer than did a nondysphoric group. Recently, Leyman et al. (2011) found that dysphoric participants dwelled longer on sad faces and neutral faces than did nondysphoric participants. Importantly, in both studies, levels of trait anxiety were not significantly associated with the attentional biases.

Continuously Assessed Depressive Symptoms

A handful of studies have tested a dimensional perspective more directly by examining the relations between continuously assessed levels of depressive symptoms and attentional biases. A subset of these investigations controlled for the influence of co-occurring levels of anxiety symptoms. Bradley et al. (1997, Study 2) administered a dot-probe task to dysphoric and non-dysphoric groups; interestingly, whereas the two groups did not differ on any measures of attentional bias, when examining correlations across the full sample and statistically controlling for trait anxiety, higher levels of depressive symptoms were associated with greater attention to negative words presented at a 1,000-ms duration. Similarly, Oehlberg et al. (2012, Study 2) administered a dot-probe task to a sample that was selected to optimize the degree of variance on measures of both depressive and anxiety symptom severity. The investigators demonstrated a statistical suppressor effect on attentional biases: whereas there
were no significant zero-order correlations between depressive symptoms and attentional biases, when controlling for anxiety symptoms, higher levels of depressive symptoms were significantly related to greater attention to sad faces at a 1,000-ms duration.

In contrast, studies that have reported only zero-order correlations between levels of depressive symptoms and attentional biases, without controlling for levels of anxiety symptoms, have documented few significant associations. For instance, using spatial cueing paradigms, Koster et al. (2006) did not find any association between depressive symptoms and biases toward sad faces at a 1,000-ms duration, and Everaert et al. (2013) did not report any relation between depressive symptoms and biases toward negative words at a 1,500-ms duration. In a subsequent investigation, however, Everaert et al. (2014) operationalized a novel eye-tracking index of attentional bias and demonstrated that higher levels of depressive symptoms were associated with more frequent and longer fixations on negative words relative to positive words. It should be noted, however, that findings have been mixed for the emotional Stroop task in MDD (Gotlib & Joormann, 2010; Wisco, 2009).

### Co-occurring Depression and Anxiety Disorders

Several studies have directly examined cognitive biases in individuals with co-occurring MDD and anxiety disorders. A major

<table>
<thead>
<tr>
<th>Study</th>
<th>Relevant participant groups or symptom measure</th>
<th>Experimental paradigm</th>
<th>Stimulus types</th>
<th>Stimulus presentation durations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caseras, Garner, Bradley, &amp; Mogg (2007)</td>
<td>Dysphoric (BDI-II &gt; 10); nondysphoric (BDI-II ≤ 6)</td>
<td>Eye tracking</td>
<td>Images: negative; positive; neutral</td>
<td>3 s</td>
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<tr>
<td>Koster, De Raedt, Goeleven, Franck, &amp; Crombez (2005)</td>
<td>Dysphoric (BDI &gt; 10); nondysphoric (BDI ≤ 4)</td>
<td>Spatial cueing</td>
<td>Words: negative; positive; neutral</td>
<td>250 ms; 500 ms; 1,500 ms</td>
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<tr>
<td>Koster, De Raedt, Leyman, &amp; De Lissnyder (2010)</td>
<td>Dysphoric (BDI-II &gt; 14); nondysphoric (BDI-II ≤ 6)</td>
<td>Spatial cueing</td>
<td>Words: negative; positive; neutral</td>
<td>250 ms</td>
</tr>
<tr>
<td>Leyman, De Raedt, Vaeysens, &amp; Philippaerts (2011)</td>
<td>Dysphoric (BDI-II &gt; 14); nondysphoric (BDI-II ≤ 11)</td>
<td>Eye tracking</td>
<td>Faces: sad; angry; happy; neutral</td>
<td>10.5 s</td>
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<tr>
<td>Bradley, Mogg, &amp; Lee (1997, Study 2)</td>
<td>BDI scores</td>
<td>Dot-probe</td>
<td>Words: depression-related; anxiety-related; neutral</td>
<td>14 ms; 500 ms; 1,000 ms</td>
</tr>
<tr>
<td>Everaert, Duyck, &amp; Koster (2014)</td>
<td>BDI-II scores</td>
<td>Eye tracking</td>
<td>Words: negative; positive; neutral</td>
<td>As long as needed to respond up to 8 s</td>
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<tr>
<td>Everaert, Tierens, Uzieblo, &amp; Koster (2013)</td>
<td>BDI-II scores</td>
<td>Spatial cueing</td>
<td>Words: negative; positive; neutral</td>
<td>1,500 ms</td>
</tr>
<tr>
<td>Koster, Leyman, Raedt, &amp; Crombez (2006)</td>
<td>DASS scores</td>
<td>Spatial cueing</td>
<td>Faces: sad; angry; happy; neutral</td>
<td>200 ms; 1,000 ms</td>
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<tr>
<td>Oehlberg, Revelle, &amp; Mineka (2012, Study 2)</td>
<td>Composite scores</td>
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<td>Faces: sad; angry; happy; neutral</td>
<td>300 ms; 1,000 ms</td>
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<tr>
<td>Yovel &amp; Mineka (2004)</td>
<td>MASQ scores</td>
<td>Emotional Stroop</td>
<td>Words: depression-related; anxiety-related; neutral</td>
<td>As long as needed to respond</td>
</tr>
<tr>
<td>Yovel &amp; Mineka (2005)</td>
<td>MASQ scores</td>
<td>Emotional Stroop</td>
<td>Words: depression-related; anxiety-related; neutral</td>
<td>17 ms; as long as needed to respond</td>
</tr>
<tr>
<td>Bradley, Mogg, Millar, &amp; White (1995)</td>
<td>GAD; GAD-DD; CTL</td>
<td>Emotional Stroop</td>
<td>Words: depression-related; anxiety-related; neutral</td>
<td>14 ms; as long as needed to respond</td>
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<tr>
<td>Dozol &amp; Dobson (2001)</td>
<td>AD; MDD; AD-MDD; CTL</td>
<td>Emotional Stroop</td>
<td>Words: negative; positive; nonlexical</td>
<td>As long as needed to respond</td>
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<tr>
<td>LeMoult &amp; Joormann (2012)</td>
<td>SAD; SAD-MDD; CTL</td>
<td>Dot-probe</td>
<td>Faces: sad; angry; disgusted; happy; neutral</td>
<td>7 ms; 1,000 ms</td>
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<tr>
<td>Mogg, Millar, &amp; Bradley (2000)</td>
<td>GAD; GAD-MDD (primarily); CTL</td>
<td>Dot-probe with eye tracking</td>
<td>Faces: sad; angry; happy; neutral</td>
<td>1,000 ms</td>
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<tr>
<td>Musa, Lépine, Clark, Mansell, &amp; Ehlers (2003)</td>
<td>SAD; SAD-DD; CTL</td>
<td>Dot-probe</td>
<td>Words: threat; neutral</td>
<td>500 ms</td>
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Note. AD = anxiety disorder; BDI = Beck Depression Inventory; BDI-II = Beck Depression Inventory-II; CTL = control; DASS = Depression Anxiety and Stress Scale; DD = unipolar depressive disorder; GAD = generalized anxiety disorder; MASQ = Mood and Anxiety Symptom Questionnaire; MDD = major depressive disorder; SAD = social anxiety disorder; dashes denote co-occurring disorders. ms = milliseconds; s = seconds.
limitation of this work is that most studies compared groups with “pure” anxiety disorders to groups with co-occurring anxiety disorders and depression, without a corresponding pure MDD group. Also importantly, it is plausible that any differences in the functioning of groups with pure versus co-occurring disorders are attributable to differing levels of symptom severity. In the majority of the studies reviewed in this article, the pure and comorbid groups did not differ in symptom severity; we note the few exceptions.

LeMoult and Joormann (2012) administered a dot-probe task to participants with social anxiety disorder (SAD) alone, with co-occurring MDD–SAD, and with no history of disorder. Surprisingly, participants with co-occurring MDD–SAD did not differ from either participants with SAD alone or controls in their attention to sad faces; instead, the MDD–SAD group exhibited greater avoidance of angry faces at a 1,000-ms stimulus duration relative to both other groups. Musa et al. (2003) also administered a dot-probe task to participants with SAD alone, with SAD and co-occurring unipolar depressive disorders, and to nondisordered controls. The investigators assessed only biases to threatening words at 500 ms and found that the group with SAD alone showed an expected bias toward threat words that was not exhibited by the group with co-occurring disorders. Mogg et al. (2000) administered a dot-probe task to slightly different groups: generalized anxiety disorder (GAD alone), MDD (within which 13 out of the 15 participants had co-occurring GAD), and no current disorder. Neither clinical group exhibited any attentional biases as assessed via response latencies; however, eye-tracking data indicated a stronger initial orienting toward angry faces in the group with GAD alone that was not shown in the group with co-occurring MDD–GAD.

Two studies have used emotional Stroop tasks to assess attentional interference. Bradley et al. (1995) found that whereas participants with GAD alone exhibited greater attentional interference for negative words, the performance of participants with co-occurring GAD and depressive disorders did not differ from that of controls. Notably, the group with co-occurring disorders had higher anxiety levels than did the group with GAD alone. Dozois and Dobson (2001) reported a different pattern of findings in a study of participants with MDD alone, with anxiety disorders alone, and with co-occurring MDD and anxiety disorders. Relative to nondisordered control participants, all three clinical groups exhibited greater interference for both negative and positive words, and did not differ from one another. Again, the comorbid group reported higher levels of anxiety symptoms than did the groups with pure disorders.

Summary of Research on Attentional Biases

In sum, research on attentional biases reveals a fairly consistent pattern of findings across dysphoric and dimensionally assessed samples that have been carefully scrutinized with respect to the influence of co-occurring anxiety on the attentional measures. Specifically, elevated levels of depressive symptoms, even those that do not reach the threshold for MDD diagnosis, are associated with more sustained attention to stimuli connoting sadness. The evidence does not support any association with an automatic attentional bias or the tendency to orient quickly to sad stimuli; rather, once sufficient time has elapsed for this material to capture attention, individuals with elevated depressive symptoms maintain their attention longer and have greater difficulties disengaging this attention.

In contrast, the small amount of previous research on attention in co-occurring depression and anxiety disorders paints a different picture. These individuals do not consistently exhibit strong attentional biases toward sad stimuli; in fact, their pattern of attention did not differ from that of nondisordered control participants across several studies. As depressive and anxiety symptoms tend to be highly associated with one another, this may be why studies that have examined zero-order correlations between levels of depressive symptoms and attentional biases, without controlling for concurrent anxiety symptoms, have produced largely nonsignificant findings. Researchers have proposed that co-occurring MDD abolishes the automatic attentional bias toward threat that otherwise characterizes individuals with anxiety disorders (Mogg, Bradley, & Williams, 1995). Conversely, co-occurring anxiety disorders may significantly decrease the strength and/or duration of attention to sad stimuli in depression. Clearly, further research is needed to elucidate patterns of attention in this highly common form of comorbidity.

Research on Memory Biases

There is strong evidence that MDD is associated with a negative memory bias, particularly an explicit memory bias, that favors themes of sadness (reviewed in Gotlib & Joormann, 2010; Wisco, 2009). MDD has also been characterized by certain biases in autobiographical memory (reviewed in Sumner, 2012; Williams et al., 2007). Next, in order to draw strong parallels to the studies examining attentional biases, we review only dimensionally relevant studies that have used experimental tasks to control stimulus inputs. Table 2 summarizes the key features of the empirical studies reviewed in what follows with respect to participant samples, implicit and explicit memory paradigms, and stimulus types.

Subclinical Depressive Symptoms

In an early meta-analysis, Matt, Vázquez, and Campbell (1992) concluded that persons with subclinical depressive symptoms exhibit symmetric or “even-handed” memory for negative and positive stimuli. Our research group (Gilboa et al., 1997) subsequently examined incidental memory for words that had been rated by participants on self-descriptiveness as well as intentional recall of novel words. Dysphoric participants did not exhibit a negative memory bias but, indeed, were even-handed in their recall of negative words versus positive and neutral words. Unfortunately, we did not assess the potential influence of anxiety levels on these results. More recently, Direnfeld and Roberts (2006) replicated this methodology. Their findings were divergent in that dysphoric participants exhibited greater
incidental memory for negative words than for positive words, rather than symmetric recall, and also did not display any biases in intentional recall of negative words. The authors did not report any data concerning anxiety symptoms in their sample.

Other recent studies have found mixed evidence for memory biases in dysphoria. For example, Koster et al. (2010) conducted a free recall test with the same sample of participants that had completed the modified spatial cueing paradigm reviewed before. The authors reported a statistical trend in which dysphoric participants recalled nonsignificantly more negative words than did nondysphoric participants. Ridout et al. (2009, Study 1) found that dysphoric participants correctly recognized more sad faces than did nondysphoric participants; moreover, within the dysphoric group, rates of recognition were higher for sad faces than for happy and neutral faces. The authors did not examine the influence of elevated anxiety scores within the dysphoric group on these effects. Finally, Ellis et al. (2011) assessed incidental recognition biases for negative and positive words. Despite displaying a differing pattern of attention relative to a nondysphoric control group, dysphoric participants did not exhibit any biases in recognition. The authors did not report any data concerning anxiety symptoms or their effects on the dependent measures.

Continuously Assessed Depressive Symptoms

Few studies have used a direct dimensional approach in testing the associations between continuously assessed levels of depressive symptoms and memory biases. Only a subset of the studies controlled for co-occurring anxiety. For instance, Bradley et al. (1996, Study 1) examined implicit memory biases in dysphoric and nondysphoric groups. In addition to demonstrating a between-group difference in memory biases for depression-relevant words in the expected direction, across the full sample severity of depressive symptoms and memory biases were significantly correlated. Importantly, anxiety levels were not associated with

<table>
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<tr>
<th>Table 2. Key features of studies of memory biases.</th>
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<tr>
<td>Study</td>
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<tr>
<td><strong>Subclinical depressive symptoms</strong></td>
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<tr>
<td>Direnfeld &amp; Roberts (2006)</td>
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<td>Ellis, Beevers, &amp; Wells (2011)</td>
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<td>Gilboa, Roberts, &amp; Gotlib (1997)</td>
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<td>Koster et al. (2010)</td>
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<td>Ridout, Noreen, &amp; Johal (2009, Study 1)</td>
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<tr>
<td><strong>Continuously assessed depressive symptoms</strong></td>
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<td>Bradley, Mogg, &amp; Millar (1996, Study 1)</td>
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<td>Everaert et al. (2014)</td>
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<td>Everaert et al. (2013)</td>
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<td>Jermann, van der Linden, &amp; D’Argembeau (2008)</td>
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<td>Dozois &amp; Dobson (2001)</td>
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<td>Gilboa-Schechtman, Erhard-Weiss, &amp; Jeczemien (2002)</td>
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<td>LeMoult &amp; Joormann (2012)</td>
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<td>Tarsia, Power, &amp; Sanavio (2003)</td>
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Note. *AD = anxiety disorder; BDI = Beck Depression Inventory; BDI-II = Beck Depression Inventory-II; CTL = control; DD = unipolar depressive disorder; GAD = generalized anxiety disorder; HAD = Hospital Anxiety and Depression Scale; MDD = major depressive disorder; SAD = social anxiety disorder; dashes denote co-occurring disorders.
these effects. Jermann et al. (2008) recruited a large sample across a range of levels of depressive symptoms. Using a remember/know/guess procedure, the authors found that higher levels of depressive symptoms were associated with a higher proportion of correctly recalled sad faces and, specifically, a higher proportion of “remember” responses for sad faces, indicating greater conscious recollection of stimulus encoding. In contrast, Noreen and Ridout (2010) reported divergent findings in participants who fell along a continuous range of levels of depressive symptoms. Whereas across the sample, levels of depressive symptoms were not significantly associated with short-term recognition of sad faces, in between-group analyses a dysphoric group showed impaired memory for all facial expressions except sadness. Levels of trait anxiety were assessed but were not covaried in the correlational analyses.

Extending their study of attentional biases, Everaert et al. (2013) also examined depressive symptoms in relation to incidental recall for negative and positive words. Zero-order correlations indicated that higher levels of depressive symptoms were associated with greater memory for negative than positive words. In the follow-up investigation, Everaert et al. (2014) replicated this significant correlation between levels of depressive symptoms and greater memory for negative than positive words, again without controlling for anxiety levels.

**Co-Occurring Depression and Anxiety Disorders**

The extant research on memory biases in co-occurring MDD and anxiety disorders is very limited. LeMoult and Joormann (2012) extended their examination of co-occurring MDD–SAD to an assessment of recognition biases for emotional faces. Both the SAD alone group and the co-occurring MDD–SAD group recognized fewer angry faces than did control participants; there were no group differences in recognition rates for sad faces or any other types of faces. In contrast, Gilboa-Schechtman et al. (2002) reported a different pattern of findings in a study of individuals diagnosed with various pure anxiety disorders, with co-occurring unipolar depressive disorders and anxiety disorders, and control participants. Across several metrics, participants with co-occurring unipolar depression and anxiety disorders exhibited consistent recognition biases in favor of angry faces over happy faces. Recognition biases in favor of sad faces were slightly less strong in this group. We should note that the group with co-occurring disorders reported higher levels of anxiety than did the group with pure anxiety disorders.

Two studies examined memory for verbal stimuli in co-occurring depression and anxiety. Dozois and Dobson (2001) conducted a self-referential encoding and incidental recall task (SRET) with their groups diagnosed with MDD alone, anxiety disorders alone, co-occurring MDD and anxiety disorders, and no history of disorder. Whereas all three clinical groups endorsed as self-relevant and subsequently recalled more negative and fewer positive words than did controls, participants both with MDD alone and with co-occurring MDD and anxiety disorders showed the lowest overall recall of positive words. Finally, Tarsia et al. (2003) recruited three clinical groups: unipolar depressive disorder alone; anxiety disorder alone; and co-occurring diagnoses of depression and anxiety disorder or diagnosis of mixed anxiety-depressive disorder (subthreshold). Whereas there was evidence for a mood-congruent recall bias in the group with depressive disorder alone, this bias was not demonstrated by the group with co-occurring depression and anxiety; the latter group instead exhibited enhanced recall of anxiety-relevant words.

**Summary of Research on Memory Biases**

In sum, previous research on memory biases suggests a different conclusion than that reached for attentional biases. Specifically, memory biases appear to be weaker and less consistently observed in dysphoria than are attentional biases. In some studies dysphoric participants exhibit symmetric memory for negative versus neutral and positive information, and across other studies the ability to demonstrate significant differences between dysphoric and nondysphoric groups appears tenuous. Several methodological issues may play a role in reaching this conclusion. For example, the studies of dysphoria reviewed before utilized a range of initial encoding processes, some of which (e.g., elaborative encoding; Watkins, 2002) likely produce stronger memory effects than others. If, however, the distinction in negative memory biases between MDD and dysphoria is veridical, this suggests that the threshold of depressive symptom severity at which memory biases emerge may be higher than the threshold at which attentional biases emerge.

Another important factor to consider is the potential influence of co-occurring anxiety on memory biases. In this regard, we should note that the effects of co-occurring anxiety symptoms and disorders were not frequently tested in the literature on dysphoria and continuously assessed depressive symptoms. Several investigations reported associations between higher levels of depressive symptoms and greater memory for sad material even without controlling for anxiety symptoms. However, only one reviewed study on co-occurring depression and anxiety disorders found support for enhanced memory specifically for sad stimuli in this population, while another study demonstrated poorer recognition of threat material in co-occurring MDD–SAD than in nondisordered controls. Additional research is needed to reconcile these conflicting findings and clarify the relative privileging of depression-relevant versus anxiety-relevant information in co-occurring depression and anxiety.

**Limitations of the Present Review**

There are three limitations of the review that warrant discussion. First, we conducted a fairly fine-grained analysis of previous work on negative attentional and memory biases in depression. Thus, we did not address other cognitive correlates of depression, such as interpretation biases and rumination, which will be important to incorporate in dimensional models (Gotlib & Joormann, 2010). Toward this aim, Mehu and Scherer...
(2015) discuss individual differences in appraisal biases and their subsequent influence on cognitive processes relevant to depression. Second, we examined individuals with subclinical dysphoria and continuously assessed levels of depressive symptom severity as candidate populations within a more dimensional model of depression. Other potential approaches include at-risk or remitted depressed samples, which may need to be conceptualized within a different dimensional framework that likely includes measures of genetic liability, family environment, and psychiatric history. Finally, our review was limited to published studies, which of course may be biased toward significant findings.

Key Empirical and Theoretical Issues to Be Addressed

With respect to broader empirical issues, in interpreting the available data on depressive symptoms in relation to attentional and memory biases, we want to emphasize that the majority of the reviewed studies used between-group designs. Whereas in some investigations the groups represented extremes of symptom distributions, in other studies the groups were formed using median splits that were imposed on more continuous symptom-level distributions. Both of these approaches may distort the true nature of the relations between levels of depressive symptoms and cognitive biases, such as underestimating or overestimating the significance of these relations or failing to capture nonlinear (i.e., quadratic) associations. Therefore, the results of these studies should be integrated with future research that uses an optimal dimensional approach in recruiting participants and analyzing the data.

With respect to theoretical implications, numerous theorists have expounded the dilemmas associated with traditional categorical models of psychopathology (e.g., Widiger & Samuel, 2005), and of depression and anxiety in particular (e.g., Mineka, Watson, & Clark, 1998), making a strong case for alternative dimensional modeling. One key conceptual framework in this regard has been the tripartite model of emotional disorders (Clark & Watson, 1991), which distinguishes among a general distress dimension that is common to depression and anxiety, an anhedonic dimension that is specific to depression, and a physiological hyperarousal dimension that is specific to anxiety. As yet, however, it is unclear how such dimensional accounts are related to patterns of cognitive processing of emotional information. For example, as we reviewed before, Oehlberg et al. (2012) recently reported that depressive symptoms and anxiety symptoms exert opposing influences on cognitive biases. These findings indicate not only that these two symptom dimensions are distinct, but further, that high levels of both depressive and anxiety symptoms may cancel out one another in the context of examining their relations to cognitive biases. Why should this be? Much more research is needed to integrate the well-validated structural accounts of emotional disorders with the growing empirical work on cognitive and emotional functioning in depression, anxiety, and their co-occurrence (e.g., Dunn et al., 2010; Larson, Nitschke, & Davidson, 2007).

Research Implications and Future Directions

The purpose of this review was to restructure and reinterpret previous research findings on negative attentional and memory biases in depression from a dimensional, in contrast to a categorical, perspective. Where do we go from here? Drawing on ideas proposed in the recent research initiative of the National Institute of Mental Health, the Research Doman Criteria (Insel, 2013), it will be important in future investigations to assess cognitive processes and their relations to depressive symptoms in a continuous manner. This approach will help to reduce significant discrepancies in studies conducted to date, such as differing operational definitions of dysphoria across studies. More importantly, this approach will inform our understanding of the “normal” or typical functioning of emotional and cognitive systems relative to dysfunction (see Scherer, 2015), aiding in identifying thresholds along the continuum of depressive symptoms at which particular cognitive biases emerge and become problematic for other domains of functioning, and at which specific interventions might be targeted. It is also possible that associations between symptom levels and cognitive and affective functioning are not linear, and that different cognitive biases are potentiated at different points along symptom dimensions (see Ingram, Siegle, & Steidtmann, 2014). One promising approach might involve the recruitment of large, continuously assessed samples while simultaneously conducting diagnostic assessments in order to compare the relative contributions of dimensional and categorical models.

In addition, levels of specific types of symptoms (e.g., anhedonia) may be usefully examined as independent dimensions that cut across a range of forms of psychopathology. In this context, Watkins (2015) describes a transdiagnostic approach to emotional disorders using the cognitive exemplar of repetitive negative thinking. Furthermore, it will be important to assess, concurrent with depressive symptoms, other relevant symptom dimensions, particularly symptoms of anxiety. Based on the literature we reviewed here, co-occurring anxiety disorders seem to affect core cognitive biases in depression; dimensional examinations of both depressive and anxiety symptom levels in relation to cognitive biases should elucidate these effects in individuals who have elevated levels of both symptom dimensions. A dimensional approach to assessing anxiety symptoms will also help to pool shared features across the anxiety disorders (e.g., anxious arousal). Finally, few investigators have examined the relations among various attentional and memory processes. Future work should integrate the assessment of different domains of cognitive functioning in order to develop a more comprehensive model of aberrant processing of emotional information.

Declaration of Conflicting Interests

None declared.

References


