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What is This?

Emotion Regulation in Depression: The Role of Biased Cognition and Reduced Cognitive Control

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Abstract
Sustained negative affect and difficulties experiencing positive affect are hallmark features of major depressive disorder. Recent research has suggested that difficulties in emotion regulation are at the core of these cardinal symptoms of major depressive disorder; depressed patients exhibit more frequent use of maladaptive emotion regulation and difficulties effectively implementing adaptive strategies. It remains unclear, however, what underlies these difficulties in emotion regulation. Cognitive theories of depression have a long tradition of focusing on cognitive factors that increase depression risk and maintain depressive episodes, but the link between cognitive and affective aspects of major depressive disorder remains to be explored. We propose that cognitive biases and deficits in cognitive control putatively associated with depression affect emotion regulation in critical ways, thereby setting the stage for maintained negative affect and diminished levels of positive affect. We close with a discussion of implications for treatment and future directions for research in this area.

Major depressive disorder (MDD) is among the most prevalent and devastating of all psychiatric disorders; it affects almost 20% of the U.S. population at some point in their lives (Kessler & Wang, 2009). Given the high prevalence and the substantial personal and societal costs of MDD, efforts to identify risk factors and underlying mechanisms as well as effective intervention strategies are particularly pressing. MDD is defined by disordered affect, specifically sustained negative affect, and difficulties experiencing positive affect (American Psychiatric Association, 2013). Theories of the onset, maintenance, and recurrence of MDD, however, have traditionally focused on cognition and behavior. Similarly, cognitive-behavioral interventions have proven successful in treating MDD by focusing on the modification of maladaptive cognitions and behaviors (Beck, Rush, Shaw & Emery, 1979). Despite these successes, many researchers have pointed out that a closer look at individual differences in the experience of and response to negative and positive affect may help to better understand vulnerability to MDD and thereby improve treatment approaches (Campbell-Sills & Barlow, 2007).

Indeed, an important assumption of cognitive theories of depression remains largely untested, that is, the idea that cognitive biases and deficits are indeed causally linked to emotional responding.

Individual differences in responses to negative events and, most important, in the regulation of emotion have been linked to heightened risk for the onset of MDD (Joormann & Siemer, 2014). Indeed, it has been proposed that individuals who experience episodes of depression differ from their nondepressed counterparts not so much in their initial responses to negative events but in their responses to the ensuing affect and, specifically, in their ability to repair or regulate negative emotion, which results in longer episodes of sadness and depressed mood (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Teasdale, 1988). Individual differences in the ability to regulate

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emotional responses may therefore play an important role in understanding depression. In this article, we review the literature on emotion regulation (ER) difficulties in depression and then examine underlying mechanisms of emotion dysregulation by focusing on basic cognitive processes that may help or hinder ER. The focus is on studies that have used clinically diagnosed samples, but studies with analogue samples are also reviewed if they are particularly informative or if clinical studies are missing. Our aim in this article is to identify important gaps in knowledge and discuss future directions for research in this area.

ER in Depression

ER is defined as strategic and automatic processes that influence the occurrence, magnitude, duration, and expression of an emotional response (Gross, 2014). ER is closely related to the construct of coping (Lazarus, 1966), even though coping usually refers to a broader construct that entails emotion-focused as well as other strategies, such as problem solving over larger periods of time (such as coping with loss). Although it is not straightforward to differentiate adaptive from maladaptive ER strategies, previous research has identified specific strategies that are less likely to effectively regulate affect and yet more likely to incur additional costs, such as heightened physiological arousal and cognitive demand (Gross & John, 2003; Webb, Miles, & Sheeran, 2012). Studies that have investigated ER in depression have focused on questions of whether depressed individuals are more prone to use maladaptive strategies and whether depression is associated with difficulties implementing more adaptive strategies (Joormann & Siemer, 2014). Whereas many researchers have examined the first question, mostly by using self-reports of habitual use of ER strategies, far fewer researchers have examined individual differences in the effectiveness of adaptive strategy use.

Maladaptive strategy use in depression

A particularly detrimental response to negative affect that has been associated with depression is rumination. *Rumination* is defined as repetitive thinking that focuses an individual's attention on his or her depressive symptoms and on the implications, causes, and meanings of these symptoms (Nolen-Hoeksema et al., 2008). The response-style theory proposes that rumination is a trait-like response to negative affect (Nolen-Hoeksema, 1991) that has been linked not only to depression but also to a range of internalizing and even some externalizing disorders. In an extensive program of correlational and experimental studies, Nolen-Hoeksema and colleagues have found that this response style exacerbates sad mood and

predicts future depressive episodes (see review by Nolen-Hoeksema et al., 2008). Given the link between rumination and increased negative affect, it may seem counterintuitive to refer to rumination as an ER strategy. However, currently depressed individuals and those at risk for the disorder frequently ruminate when they experience negative affect or after they encounter a negative event. Furthermore, studies have shown that depressed individuals perceive many benefits of rumination, such as feelings of increased self-awareness and understanding (Papageorgiou & Wells, 2001). Lyubomirksy and Nolen-Hoeksema (1993), for example, reported that rumination was associated with an enhanced sense of insightfulness. In addition, ruminative responses to negative affect frequently occur as a more automatic response to experiencing negative affect (Hertel, 2004), but they may be difficult to control and terminate, even if unwanted.

Considerable evidence has linked higher trait rumination with the onset and maintenance of depression (see Nolen-Hoeksema et al., 2008, for a review). Moreover, studies have shown that rumination mediates the gender difference in depressive symptoms (Nolen-Hoeksema, 2000; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007). Research also has indicated that rumination enhances cognitive biases (e.g., Lyubomirksy & Nolen-Hoeksema, 1995) and impairs recovery from acute stressors (Stewart, Mazurka, Bond, Wynne-Edwards, & Harkness, 2013). Rumination in these studies was usually contrasted with distraction, another ER strategy that we discuss later. In general, compared with distraction, rumination leads to sustained negative mood, increased negative cognitions, increased overgeneral autobiographical memory, and decreased effective problem solving in depressed participants (e.g., Watkins & Moulds, 2005; Watkins, Teasdale, & Williams, 2000). The tendency to ruminate has also been shown to be associated with aberrant activity in the limbic system, an area of the brain associated with emotional responding. Specifically, a recent study has shown that among previously depressed individuals, greater limbic activity in response to negative images and less activity in response to positive images was associated with higher levels of habitual rumination. It is interesting that this relation was not observed among healthy individuals (Thomas et al., 2011).

What characterizes rumination and differentiates it from negative automatic thoughts is that it is a *style* of thought rather than just negative *content* (Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 2008). Thus, rumination is defined by the process of recurring thoughts and ideas often described as a "recycling" of thoughts and not necessarily by the content of these recurring thoughts. It is interesting, therefore, that recent studies have also focused on rumination in response to positive affect in depression. Dysphoric and depressed

individuals, for example, reported attempting to ruminate on positive affect less frequently than did healthy control participants (Werner-Seidler, Banks, Dunn, & Moulds, 2013). In healthy individuals, rumination in the context of positive events often takes the form of upregulating and maintaining the positive affect, and the absence of such a response in depression may be related to anhedonia, although this remains to be tested.

In addition, depression has been shown to be associated with a ruminative response that involves attempts to dampen or reduce the experience of positive affect. A self-reported dampening response to positive affect, for example, predicted depressive symptoms in 3- and 5-month follow-up assessments in two nonclinical student samples (Raes, Smets, Nelis, & Schoofs, 2012). Similarly, Werner-Seidler et al. (2013) reported that dysphoria, current MDD, and a history of depressive episodes were each associated with increased dampening of positive affect. In addition, this dampening response was uniquely related to anhedonia symptoms. Neuroimaging studies also have suggested that depression may be characterized by attempts to dampen positive affect. For example, participants with MDD, compared with healthy control participants, showed greater activity in the dorsolateral prefrontal cortex (DLPFC) in response to positive images (Demenescu et al., 2011). Although the authors concluded that increased activity in the DLPFC might reflect greater demands of ER during exposure to mood-incongruent stimuli, an alternative explanation is that increased DLPFC activity may reflect active dampening of elicited positive affect. However, this possibility remains to be tested and represents an exciting area for future research.

In sum, these studies suggest that rumination in response to negative affect as well as rumination in response to positive affect in the form of dampening may play an important role in depression, thereby resulting in sustained negative mood, decreases in positive affect, and enhanced cognitive biases. It should be kept in mind, however, that higher trait rumination has been shown to be associated with the onset and maintenance of other internalizing and even some externalizing disorders, and recent models have suggested that rumination may be an important transdiagnostic risk factor (see Nolen-Hoeksema et al., 2008, for a review; McEvoy, Watson, Watkins, & Nathan, 2013). Still, a recent meta-analysis reported that even though rumination was elevated in mood and anxiety disorders, participants with mood disorders, compared with those with anxiety disorders, reported significantly more rumination (Olantunji, Naragon-Gainey, & Wolitzky-Taylor, 2013).

In addition to rumination, studies on ER in depression have investigated the use of suppression, which has long been regarded as a particularly maladaptive regulation strategy (Gross & John, 2003). Suppression is conceptualized as an ER strategy by which an individual attempts to inhibit the effects of external cues on internal (e.g., physiological) and external (e.g., emotional expression) states. The inhibition of emotion expression is frequently referred to as "expressive suppression." Research on emotion suppression has demonstrated that habitual use of this strategy not only is largely ineffective in reducing negative emotions but also increases physiological arousal and cognitive load. Findings have indicated that expressive suppression, for example, is associated with increased depression symptoms (Joormann & Gotlib, 2010). Moreover, emotion suppression has been associated with increased use of rumination (Liverant, Kamholz, Sloan, & Brown, 2011). Even though one study has indicated that providing instructions on the use of expressive suppression in response to negative stimuli may be efficacious in reducing acute emotional responding among depressed participants (Liverant, Brown, Barlow, & Roemer, 2008), other studies have reported a link to increased depressive symptoms and negative affect. For example, in a clinical sample that included depressed and anxious participants, Campbell-Sills, Barlow, Brown, and Hofmann (2006) examined emotion suppression using a mood-induction film and the assessment of spontaneous use of ER strategies. They reported that clinical participants used more suppression, relative to control participants, and that suppression was related to higher levels of negative affect. In addition, a recent prospective study has suggested that depression may be a precursor of habitual use of suppression in adolescence (Larsen et al., 2013). The findings of these studies suggested that use of suppression not only may be related to depression but also may again represent a transdiagnostic risk factor, similar to rumination.

Depression may be associated with suppression of positive emotion as well as negative emotion. Similar to findings on dampening in depression, Beblo et al. (2012) found that a diagnosis of MDD was associated with increased self-reported suppression of both negative and positive emotions, which was also related to symptom severity. Beblo et al. discussed fear of emotion as a potential underlying mechanism, which fits nicely with a recent finding by Werner-Seidler et al. (2013) that dysphoria was associated with apprehension about experiencing intense emotions. Difficulties enhancing and maintaining positive emotion in addition to active dampening of positive affect may help explain anhedonia symptoms in MDD.

Use and implementation of adaptive strategies in depression

In addition to the more frequent use of maladaptive strategies, depression may be characterized by decreased use

of and difficulties implementing more adaptive strategies, such as reappraisal. The tendency to interpret emotion-eliciting situations in a negative way is a defining feature of depressive disorders (Beck, 1967). Altering these interpretations is a powerful way to regulate affect and a main component of cognitive therapy for depression. Reappraisal involves changing a situation's meaning to alter one's emotional response to the situation (Gross, 1998; Gross & John, 2003). Reappraisal has been studied extensively in nonclinical populations and has been shown to reduce negative affect (John & Gross, 2004; Urry, 2009). In addition, reappraisal does not entail the social and cognitive costs associated with rumination and other less adaptive strategies (Richards & Gross, 2000). Furthermore, reappraisal has been associated with reduced physiological activation in response to negative emotion (Ray, McRae, Ochsner, & Gross, 2010; Urry, 2009).

It is not surprising that in studies of clinical and nonclinical samples, researchers have tied less frequent habitual use of reappraisal to greater depression severity (Garnefski & Kraaij, 2006; Joormann & Gotlib, 2010). It should be noted, however, that most of these studies have used a cross-sectional design, which makes it difficult to examine whether decreased reappraisal use is a symptom of depression or, indeed, a risk factor. Reduced use of reappraisal, for example, was reported in a clinical sample diagnosed with depression and anxiety (Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002). It is interesting that in a recent meta-analysis, Aldao, Nolen-Hoeksema, and Schweizer (2010) reported that whereas greater reappraisal use was related to lower depression and anxiety symptoms, reappraisal was more inconsistently related to symptoms than were other strategies (rumination, suppression). In a follow-up study, Aldao and Nolen-Hoeksema (2012) found that the degree to which reappraisal is adaptive depends on the frequency of maladaptive strategy use; reappraisal was related to lower depression symptoms but only for individuals who frequently use maladaptive strategies (rumination, suppression, etc.). The authors argued that reappraisal serves as a compensatory strategy to counteract the problems that come with greater maladaptive strategy use. These findings are particularly noteworthy, given that they suggest that focusing on the habitual use of one specific strategy is limited. Instead, it may be critical to examine the relation between use of adaptive and maladaptive strategies and psychopathology.

Studies with clinical samples that investigate the use of a range of different ER strategies may therefore be particularly informative. In a recent study, for example, D'Avanzato, Joormann, Siemer, and Gotlib (2013) compared a diagnosed depressed sample of individuals with participants diagnosed with social anxiety disorder and healthy control individuals in their habitual use of different ER strategies.

Compared with control participants, depressed participants were more likely to ruminate and less likely to use reappraisal, whereas participants with social anxiety disorder reported more expressive suppression compared with both groups. In addition, although elevated rumination was found in previously depressed participants who were not currently depressed, healthy control participants and the previously depressed group did not differ on use of reappraisal or expressive suppression. It is notable that use of reappraisal and rumination were related to symptom severity across all samples, whereas expressive suppression use was unrelated to depressive or anxiety symptoms.

These results are consistent with findings from a study by Ehring, Tuschen-Caffier, Schnülle, Fischer, and Gross (2010) in which they compared formerly depressed participants with never-depressed participants. Like D'Avanzato et al. (2013), Ehring et al. reported that formerly depressed participants showed more rumination but did not differ from never-depressed participants in their reported use of reappraisal or suppression. In addition, the formerly depressed group reported more emotion nonacceptance. This result fits nicely with the previously mentioned findings by Werner-Seidler et al. (2013) and Beblo et al. (2012) that depression is associated with fear of emotion and apprehension about experiencing intense emotion. It is interesting that even though the groups did not differ on habitual use of suppression, the formerly depressed group reported more spontaneous use of suppression in response to a negative film clip. No group differences were found in reappraisal use in response to the film clip. Ehring et al. interpreted this finding by suggesting that depression may not be associated with suppression of all emotional experiences but, rather, with the specific suppression of sadness. Further studies are needed to examine this possibility more closely.

In addition to investigating the relation between habitual reappraisal use and depression, studies have focused on whether reappraisal is actually less effective in clinical populations. These studies typically instruct participants to use a strategy such as reappraisal during an emotion-eliciting event and then assess affect before and after the use of the strategy, as well as psychophysiological indicators of arousal during strategy use. Only a handful of studies have investigated the effectiveness of reappraisal in depression, and results are mixed. Moreover, to our knowledge, only one study has focused on whether current MDD is associated with less effective reappraisal use. In a nonclinical sample of individuals who had recently experienced a stressful life event, for example, elevated depression symptoms were related to less effective reappraisal in response to an emotion-eliciting film clip (Troy, Wilhelm, Shallcross & Mauss, 2010). Similarly,

individuals lower in well-being (composite of lower positive affect, higher negative affect, and lower life satisfaction) exhibited reduced effectiveness of reappraisal to negative emotional pictures, and performance on this task was related to reduced habitual use of reappraisal (McRae, Jacobs, Ray, John & Gross, 2012).

In contrast, Ehring et al. (2010) reported that even though formerly depressed participants were less likely to endorse the use of reappraisal using self-report, they did not differ from the control group in their ability to effectively use reappraisal when explicitly instructed to do so. Indeed, these authors summarized their results by saying that formerly depressed participants choose ineffective strategies but can use more functional strategies if so instructed. Finally, Ellis, Vanderlind, and Beevers (2012) assigned currently depressed and healthy individuals to one of three ER strategies—reappraisal, acceptance, or no instruction—and had them complete an anger-eliciting task. The authors found that, in comparison with individuals assigned to the acceptance condition, participants in the reappraisal condition reported less change in anger across the frustrating task. However, participants in the reappraisal condition did not differ from those assigned to the no-instruction condition, and the authors did not observe an ER strategy by diagnostic group interaction. This preliminary evidence suggests that MDD individuals are as able as healthy control individuals to reappraise when they experience anger. However, future research is needed to explore whether these findings extend to sadness.

Neuroimaging studies on the use of reappraisal during emotional-information processing have suggested that depression is associated with less effective use of reappraisal. Brain regions associated with cognitive control over emotions (e.g., DLPFC) have also been linked to the instructed use of reappraisal, and Johnstone, van Reekum, Urry, Kalin, and Davidson (2007) found that nondepressed individuals, but not their depressed counterparts, displayed both increased DLPFC activation and decreased amygdala activation when they reappraised emotional pictures. This pattern suggests depression-related difficulties in recruiting brain regions involved in the cognitive control of emotions during instructed reappraisal. Furthermore, there is evidence that difficulty reappraising is not solely a symptom of depression. In a recent study, for example, previously depressed and healthy participants were instructed to reappraise during exposure to emotional images (Kanske, Heissler, Schönfelder, & Wessa, 2012). The results showed a deficit in the downregulation of amygdala responding to negative stimuli in the remitted group and an interesting relation between the capacity to downregulate and habitual reappraisal use as assessed by self-report (see also Drabant, McRae, Manuck, Hariri, & Gross, 2009). Kanske et al. (2012)

reported no group difference in initial amygdala response to the emotional pictures, which suggests that only the downregulation of amygdala activity is affected by a history of depression (see also Sheline et al., 2001). Depression-related difficulties in reappraisal, however, may be restricted to severely depressed individuals (Dillon & Pizzagalli, 2013).

Another strategy that is generally regarded as adaptive is distraction. Distraction is frequently used as a control condition in rumination studies, and many studies have shown that distraction seems to regulate affect effectively in depressed participants (see Nolen-Hoeksema et al., 2008, for a review). Whereas depressed participants instructed to ruminate show increased negative affect and recall of negative memories, depressed participants instructed to distract do not differ from the control group on these measures. For example, in a study on mood repair in depression, Joormann, Siemer, and Gotlib (2007) induced currently, formerly, and never-depressed participants into a sad mood and then instructed them to use distraction. The authors found that currently and formerly depressed participants did not differ from control participants in their affect recovery, thereby suggesting that depressed participants are able to use distraction to effectively regulate negative affect. However, even though distraction may be an effective strategy, depressed and dysphoric individuals may be less likely to use it. Lyubomirsky and Nolen-Hoeksema (1993), for example, reported that dysphoric participants induced to ruminate reported less willingness to engage in pleasant, distracting activities. Indeed, the authors suggested that dysphoric participants may avoid distraction because it may interfere with their efforts to gain insight into their problems.

Previous studies also have focused on the recall of mood-incongruent, usually positive, material in depression (Joormann, Siemer, & Gotlib, 2007). In these studies, participants did not receive explicit instructions to regulate affect. Instead, they were informed that the project was investigating memory processes and were asked to recall mood-incongruent memories (i.e., recall of a positive autobiographical memory immediately after a negative-mood induction). Recall of mood-incongruent memories was compared with a distraction condition. Results showed that, relative to control participants, dysphoric as well as currently depressed and formerly depressed participants did not experience a recovery in their negative affect when they recalled mood-incongruent memories (Joormann, Siemer, & Gotlib, 2007; see also Werner-Seidler & Moulds, 2012). Distraction, however, repaired negative affect in all groups. Moreover, recent functional MRI findings have shown that risk for depression is characterized by difficulties using mood-incongruent recall in the service of mood repair. For

example, Joormann, Cooney, Henry, and Gotlib (2012) found that girls at high risk for depression, as a result of their mother's history of depressive episodes, but free of any current or past psychopathology showed, relative to their low-risk counterparts, increased amygdala responding to a mood induction and failure to downregulate this activation using positive-memory recall. Altogether, these results suggest that depression and risk for the disorder are associated with an inability to focus on positive material to offset negative affect, which may be an important automatic mood-repair mechanism and, thus, make one more vulnerable for developing the disorder.

These results mirror findings that have shown that depression is associated with difficulties in the processing of positive material and in the use of positive material to offset negative affect. When instructed to enhance and maintain positive affect, for example, MDD individuals exhibited difficulty sustaining nucleus accumbens activation over time (Heller et al., 2009). Furthermore, this difficulty was related to individual differences in self-reported positive affect. Heller et al. (2009) interpreted these findings as showing that depressed participants have difficulties sustaining engagement of brain areas involved in positive affect and reward over time.

In sum, the results show that depression is characterized by increased use of rumination and less use of reappraisal. There is some indication that rumination use may be a stable feature of depression risk, evident even outside of acute episodes of the disorder, whereas reduced use of reappraisal may be observed only in people who are currently depressed (see D'Avanzato et al., 2013; Ehring et al., 2010). In addition, findings are mixed when it comes to the question whether depressed people differ from their nondepressed counterparts in their ability to reappraise; more research clearly is needed to clarify this pattern of findings. Results for expressive suppression and other forms of suppression are also less clear-cut and should be a focus in future studies. It is interesting, however, that recent studies have suggested that emotion nonacceptance and fear of intense emotion may characterize depression (Beblo et al., 2012; Werner-Seidler et al., 2013). In addition, preliminary evidence has suggested that depressed individuals show maladaptive responses to positive affect and exhibit difficulties in using positive material to regulate emotions. Indeed, depression has been associated with rumination not only in response to negative events but also in the form of dampening when encountering positive affect. In addition, depression has been associated with difficulties using positive autobiographical memories to repair negative mood. Examination of positive-affect regulation in depression represents a very exciting area of future research.

However, it is not clear what underlies the preference and dispositional use of specific ER strategies in depression. It is likely that difficulties implementing certain strategies also shape the selection of ER strategies. It therefore seems important to try to identify processes that may underlie difficulties in ER. Why do depressed people use maladaptive strategies, and why do they find it difficult to use adaptive strategies? Cognitive theories of emotional disorders have identified mood-congruent biases in the processing of emotional information, and recent research has focused on deficits in cognitive control that may interfere with ER (Joormann, 2010). These studies may improve insight into mechanisms that underlie difficulties in ER and mood regulation and thereby provide critical information for interventions.

Cognitive Processes and ER in Depression

Cognition plays a critical role in human emotion. According to cognitive theories of emotion, cognitive appraisals of emotion-eliciting situations determine if an emotion is experienced and which emotion is experienced (Lazarus & Folkman, 1984). Cognition, therefore, is also a primary route through which emotions are regulated. Consequently, individual differences in attention, memory, interpretation, and cognitive control may affect people's ability to regulate affect, thereby providing the basis for an increased vulnerability to depression and other psychological disorders (Joormann, Yoon, & Siemer, 2010). Specifically, it is proposed that depression is associated with mood-congruent attention, memory, and interpretation biases. At the same time, deficits in cognitive control impair the ability to reinterpret the situation in a more adaptive way, which interferes with the use of adaptive strategies (e.g., reappraisal) and sets the stage for increased use of maladaptive strategies (e.g., rumination; see Fig. 1 for a schematic illustration of cognitive processes and emotion dysregulation in depression). The next sections provide a review of evidence that documents biased cognition and diminished cognitive control associated with MDD. In addition, we highlight studies that link these biases and deficits to difficulties in ER.

Perception and attention

Individual differences in early perception of emotional material and in the tendency to orient toward these stimuli, as well as a person's ability to disengage from emotional stimuli, are important factors that may influence ER when confronted with an emotion-eliciting situation. The question whether depression is associated with enhanced and maybe even automatic perception of emotional stimuli has been investigated in studies using either subliminal material, material with low degrees of emotional intensity, or very fast presentation times. Researchers
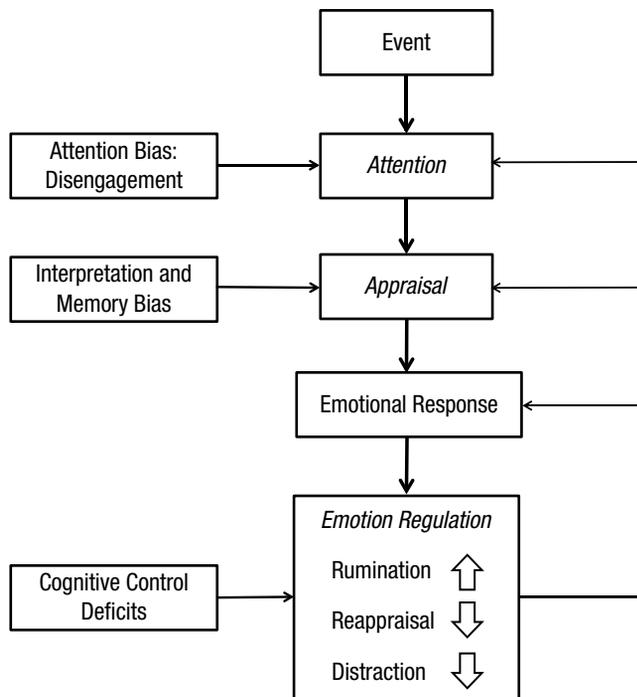
Fig. 1. Schematic illustration of cognitive processes and emotion dysregulation in depression. Cognitive biases, such as difficulties disengaging from negative material and biases in interpretation and memory, affect attention to emotion-eliciting aspects of events as well as the appraisals of the event, which, in turn, affect the emotion response. Through their effect on attention and appraisal processes, cognitive biases also interfere with emotion regulation. In addition, cognitive control deficits further impair the effective implementation of emotion-regulation strategies, such as reappraisal, distraction, and mood-incongruent recall, thereby increasing the likelihood of maladaptive responding, for example, in the form of rumination.

have used disorder-specific material or material that is relevant to emotion across disorders, such as facial expressions of emotion. It is striking that few studies to date have demonstrated biases in clinically depressed participants when depression-relevant (or other) stimuli have been masked to investigate unconscious processing (see Mathews & MacLeod, 2005; Teachman, Joormann, Steinman, & Gotlib, 2012, for reviews).

The evidence for attention biases in depression is also mixed. In the emotional Stroop task, individuals with depression should take longer to respond to the color of the negative words compared with the neutral words, thereby suggesting that their attention was "grabbed" by the content of the words. Yet studies have shown that whereas anxious participants exhibited slower color naming of all negative words at both subliminal and supraliminal exposure durations, depressed participants did not differ from control participants in the subliminal condition (Lim & Kim, 2005; Mogg, Bradley, Williams, & Mathews, 1993). Several investigators have used the dot-probe task with briefly presented

and masked emotional words to investigate automatic processing biases in depression. In the dot-probe task, a pair of stimuli (words or faces) is presented simultaneously: one stimulus is neutral and the other is emotional. Participants are asked to respond to a probe that replaces the neutral or the emotional stimulus. Allocation of attention to the spatial position of the stimuli is determined from response latencies to the probes. Here, too, the results have not been encouraging when words were presented briefly and masked (e.g., Donaldson, Lam, & Mathews, 2007; Mogg et al., 1993).

Taken together, empirical findings that depression is associated with the easy identification of mood-congruent material or a fast orienting toward negative stimuli are rather mixed. In contrast, many studies have shown the presence of such biases in anxiety and other emotional disorders (Mathews & MacLeod, 2005). There is evidence, however, that depressed persons are characterized by attentional biases in later stages of processing. Researchers using the dot-probe task, for example, have reported selective attention in depression but only under conditions of long stimuli exposures (e.g., Bradley, Mogg, & Lee, 1997; Donaldson et al., 2007; Joormann & Gotlib, 2007). Evidence for these biases has also been found in remitted depressed adults and high-risk offspring (Joormann & Gotlib, 2007; Joormann, Talbot, & Gotlib, 2007), which suggests that these attentional biases are not simply a symptom of depression or a scar of a previous depressive episode but may play an important role in the vulnerability to depression.

Whereas the dot-probe task has been criticized as a measure of disengagement, similar difficulties in disengaging attention from negative material have now been demonstrated in various attention tasks (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Rinck & Becker, 2005). In addition, eye-tracking studies have shown that depressed participants do not necessarily exhibit increased attentional engagement with negative stimuli but do have difficulties disengaging their attention from negative material (Caseras, Garner, Bradley, & Mogg, 2007; Eizenman et al., 2003; Sanchez, Vazquez, Marker, LeMoult, & Joormann, 2013). Furthermore, there is evidence that depressed individuals spend less time attending to positive material. For example, Sears, Newman, Ference, and Thomas (2011) reported that dysphoric and previously depressed participants, compared with never-depressed individuals, spent less time attending to positive images. Similar results have been observed when clinical samples were compared with healthy control participants (Kellough, Beevers, Ellis, & Wells, 2008).

A link among cognitive biases and emotional responding has been reported in studies focused on whether individual differences in attention biases are associated with emotional reactivity to a stressor or mood induction.

Compton, Heller, Banich, Palmieri, and Miller (2000), for example, demonstrated that a reduced ability to disengage attention was associated with increased reactivity to a distressing film clip. Individual differences in orienting, however, were not related to the mood response. Beevers and Carver (2003) demonstrated that changes in attentional bias for negative words but not for positive words in response to a negative mood induction interacted with life stress to predict onset of depressive symptoms in college students. In a recent study on attentional bias in depression, Sanchez et al. (2013) found that attentional-disengagement difficulties were not only characteristic of MDD but also related to individual differences in mood changes in response to a stress task, a finding that suggests a close link between attention disengagement and emotion reactivity. Likewise, Clasen, Wells, Ellis, and Beevers (2013) reported that attention biases to sad stimuli were associated with greater impairments in mood recovery in MDD participants.

Whereas the previous studies reported associations between individual differences in cognitive biases and emotional responses to stressors, Ellenbogen, Schwartzman, Stewart, and Walker (2002) examined more directly whether attentional deployment while exposed to a stressor predicts emotional responding. These authors found that people under a negative stress induction were faster to shift attention away from negative words compared with positive and neutral words and that these attentional shifts were associated with mood changes in response to the stressor. Ellenbogen et al. reported further that people with elevated depression scores had difficulties shifting attention away from emotional stimuli. Likewise, Johnson (2009) demonstrated that participants who switched faster to the emotional material were more frustrated by a stressful task. Johnson also found that participants who were better able to focus on happy faces and to avoid angry faces in a dot-probe task were less frustrated and worked harder in a stressful anagram task.

Whereas these studies suggest that attention biases are associated with emotional responding, a more direct proof for the causal role of cognitive biases in emotion generation and ER would require evidence that changes in cognitive processes are related to changes in emotional states. The only set of studies that have provided this more direct test comes from recent work on cognitive-bias modification. These studies aim to retrain people's cognitive processing, which, in theory, should enable them to more effectively respond to emotion-eliciting situations. It is important to note that these studies use control groups that do not undergo the training, which allows the researchers to conclude that the training leads to the changes in emotional responding in the experimental group compared with the control group. In

a typical training paradigm, the dot probe is presented more consistently after the nonthreat relevant stimuli (rather than equally after threat and nonthreat stimuli) so that participants learn to attend to neutral stimuli and away from threat stimuli. These studies have demonstrated that training highly anxious people to disengage their attention from threat material leads to changes in mood and reduced reactivity to stressful events. MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002), for example, first established that attentional biases could be modified by working with participants who scored in the middle third of the distribution on the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). They found that after attentional training away from threat, participants reported reduced negative affect to a standardized stress manipulation. They also demonstrated that the changes in emotional responding were mediated by the training-induced changes in biases.

A more recent study of attentional-bias training extended the findings of MacLeod et al. (2002) by showing that positive attentional biases can be trained (Wadlinger & Isaacowitz, 2008). Participants who had been trained to attend to positive stimuli subsequently looked less at negative images during a stress induction (Wadlinger & Isaacowitz, 2008). So far, most of these studies have been conducted with samples of patients with anxiety disorders, but at least two recent studies have provided encouraging data that a training aimed at modifying attention biases may also apply to depression (Baert, Koster, & De Raedt, 2011; Wells & Beevers, 2010). No studies thus far, however, have investigated whether modifying cognitive biases in depressed participants leads to changes in the use or effectiveness of ER strategies and, thus, to changes in emotional responding. This clearly presents an important direction for future research.

What are the implications of these depression-related biases in perception and attention for ER? Depression does not seem to be characterized by high sensitivity toward the detection of emotion-eliciting stimuli. Instead, depression is mostly associated with difficulties in attentional disengagement. Difficulties disengaging from negative stimuli may preclude depressed people from using effective ER strategies, such as distraction, when confronted with stressful events and may result in the sustained processing of emotion-eliciting stimuli and lead to prolonged negative affect. In addition, attentional biases toward negative material may interfere with a person's ability to successfully reframe emotion-eliciting events. Being "stuck" in attending to negative aspects of the situation may make it more difficult to shift attention to more positive aspects, thus hindering a more balanced appraisal of the emotion-eliciting event. Consistent with this idea is Koster, De Lissnyder, Derakshan and De Raedt's (2011) proposition that rumination may underlie the relation

between attentional disengagement and emotional responding. The authors suggested that an inability to disengage attention from mood-congruent stimuli may facilitate prolonged processing of such material (i.e., rumination), thereby hindering the use of an adaptive ER strategy. Depressed individuals also show attentional biases away from positive material. Attentional avoidance of positive material may underlie difficulties upregulating positive affect or using positive material to regulate negative affect. However, these questions have yet to be examined empirically.

Interpretation

Most situations that evoke emotions are ambiguous. How cues in these situations are initially interpreted and appraised determines the emotional response and determines whether this response is appropriate in this situation or not. Reinterpretation or reappraisal is a potent ER strategy because it allows flexible emotional responding without changing the situation and without ignoring the emotion-eliciting cues. Biases in interpretation, especially if they are automatic, can make it difficult to use reappraisal and can lead to inflexible and inappropriate responding (Siemer & Reisenzein, 2007). Negative-interpretation biases could result in rigid, automatic mood-congruent interpretations of potentially emotion-eliciting events and may make it difficult to see the situation from a different perspective or to entertain alternative interpretations.

Results, however, are mixed with regard to whether depression is characterized by automatic interpretation biases (Lawson, MacLeod, & Hammond, 2002). Butler and Mathews (1983), for example, presented clinically depressed participants with ambiguous scenarios and found that, compared with nondepressed participants, depressed individuals ranked negative interpretations higher than they did other possible interpretations. In a study in which researchers assessed biases by using response latencies to target words that were presented after ambiguous sentences, no interpretation bias was found (Lawson & MacLeod, 1999; see also Bisson & Sears, 2007). Lawson et al. (2002) examined startle magnitude during imagery elicited by emotionally ambiguous text. Using this measure, these authors reported evidence for more negative interpretations in their depressed sample and concluded that the failure to find a bias in previous studies was due to the use of response latencies. Cowden Hindash and Amir (2012), however, found evidence for a negative-interpretation bias in dysphoric individuals as indexed by faster response times to endorse an association between negative words and ambiguous sentences. The authors suggested that their use of self-referent material, as opposed to other-referent material, may explain

the previous null findings in studies that used response time paradigms. Furthermore, a recent study reported a negative-interpretation bias in never-disordered daughters of depressed mothers, thereby providing evidence for a role of these biases in increasing risk for depression onset (Dearing & Gotlib, 2009). Thus, even though some studies have reported negative findings, there is evidence for biased interpretation in depression.

Researchers recently have begun to modify interpretive biases in the hopes of modifying emotional responding. Mathews and Mackintosh (2000) used ambiguous scenarios to train individuals to make either positive (nonanxious) or negative (anxious) interpretations of ambiguous text in a sample of anxious individuals. The authors compared state-anxiety levels prior to and after the training and reported that participants in the negative-training condition displayed elevated levels of anxiety, whereas those in the positive-training condition demonstrated decreased symptoms of anxiety. These findings support the hypothesis that interpretive biases play a causal role in anxiety levels. Yiend, Mackintosh, and Mathews (2005) demonstrated that the effects of interpretive training on anxiety were still present after a 24-hr delay between the training and a subsequent test. In a related study, participants who received interpretive training using ambiguous homophones were subsequently presented four distressing television clips of real-life emergency rescue situations (Wilson, MacLeod, Mathews, & Rutherford, 2006). Participants who were trained to interpret ambiguity in a nonthreatening manner had an attenuated anxiety reaction to the subsequent video stressor (see also Mackintosh, Mathews, Yiend, Ridgeway, & Cook, 2006). Furthermore, Beard and Amir (2008) reported that changes in negative emotion were mediated by training-induced changes in negative interpretive style. These results suggest that changes in interpretation biases can indeed lead to changes in emotional responding. In one of the first studies to investigate interpretation-bias training in depression, A. D. Williams, Blackwell, Mackenzie, Holmes, and Andrews (2013) showed that this training resulted in reduction of depressive symptoms and that the symptom reduction was partially mediated by the changes in interpretation bias.

Unfortunately, no studies so far have investigated whether changes in interpretive biases in these training studies lead to changes in emotional responding by affecting people's ability to use reappraisal when confronted with emotion-eliciting situations. Thus, these studies show that interpretive biases can lead to changes in emotional responding but do not show that changes in the use or effectiveness of reappraisal is the mechanism underlying this change. In addition, previous studies have focused primarily on anxiety, and no studies so far have investigated whether modifying interpretive biases

in depression affects emotional responding. To summarize, the described studies suggest that depression is characterized by biases in interpretation. Studies that directly link interpretive biases to difficulties in ER are an important area for future research.

Memory

Memories affect emotion in important ways. Recent studies have demonstrated that memories of unpleasant events, compared with pleasant events, fade faster and that this differential fading is associated with happiness (Walker, Skowronski, Gibbons, Vogl, & Thompson, 2003); that recalling positive autobiographical memories can repair an induced negative-mood state (Joormann & Siemer, 2004); and that remembering positive events and forgetting negative events is associated with increased well-being over the life span (Charles, Mather, & Carstensen, 2003). Indeed, mood-incongruent recall is often used as a mood-repair strategy in response to a negative-mood induction (e.g. Rusting & DeHart, 2000). Memory biases, such as increased accessibility of negative autobiographical material, may lead to difficulties in accessing mood-incongruent material, which may interfere with the selection and use of effective ER strategies. Memory biases may also determine people's perception of a specific situation, change their appraisals, and guide their attention toward specific aspects of that situation. It is not surprising that preferential recall of negative material compared with positive material is one of the most robust findings in the depression literature (Mathews & MacLeod, 2005; Matt, Vazquez, & Campbell, 1992).

Depression has been associated with not only enhanced recall of negative events but also the recall of rather generic memories despite instructions to recall specific events (i.e., overgeneral memory; see J. M. G. Williams et al., 2007, for a review). Furthermore, the extent to which an individual retrieves overgeneral memories predicted delayed recovery from affective disorders (e.g., Dalgleish, Spinks, Yiend, & Kuyken, 2001). In addition, studies have shown that rumination may maintain overgeneral memory in depressed patients (Watkins & Teasdale, 2001, 2004). Understanding overgeneral memory in the context of ER in depression may therefore be an important goal for future research. One particularly promising study demonstrated that training dysphoric individuals to be more concrete and less overgeneral in their thinking led to a significant reduction in depressive symptoms and rumination (Watkins, Baeyens, & Read, 2009; see, however, Mogoaşe, Brăilean, & David, 2013, who reported no effect of concreteness training on rumination or depression).

In sum, memory biases are important to consider in depression. Depression has been associated with increased accessibility of negative material and overgeneral memories. In addition, mood-congruent recall and reduced accessibility of mood-incongruent material may contribute to difficulties using ER strategies, such as reappraisal, but studies on this association are still needed.

Cognitive control

Overriding prepotent responses and inhibiting the processing of irrelevant material that captures attention are core abilities that allow individuals to respond flexibly and to adjust behavior and emotional responses to changing situations. Cognitive control is related to the functioning of executive-control processes, such as inhibition, disengagement, and updating in working memory (Hasher, Zacks, & May, 1999; Miyake & Friedman, 2012). Working memory is a limited-capacity system that provides temporary access to a select set of representations in the service of current cognitive processes (Cowan, 1999; Miyake & Shah, 1999). Thus, working memory reflects the focus of attention and the temporary activation of representations that are the contents of awareness. Given the capacity limitation of this system, it is important that the contents of working memory be updated efficiently, which is a task controlled by executive processes (e.g., Friedman & Miyake, 2004; Hasher et al., 1999). Executive processes must selectively gate access to working memory, shielding it from intrusion from irrelevant material, as well as discard information that is no longer relevant. In this context, individual differences in the experience and resolution of interference are likely to affect cognitive and emotional functioning. The occurrence of intrusive thoughts might be one consequence of poor interference resolution. Several researchers have suggested that rumination and depression are associated with deficits in executive functioning (Hertel, 1997; Joormann, 2005; Whitmer & Gotlib, 2012).

Deficits in controlling the contents of working memory may affect ER because the experience of a mood state or an emotion is generally associated with the activation of mood-congruent representations in working memory (Siemer, 2005). In addition, effective reappraisal may depend on a person's ability to override (automatic) attention and interpretation biases that lead to unwanted appraisals of the emotion-eliciting cues. The replacement of automatic appraisals with alternative evaluations of the situation requires cognitive control. The ability to control the contents of working memory might therefore play an important role in ER. Thus, an inability to appropriately expel mood-congruent items from working memory, as they become irrelevant, would lead to difficulties attending to and processing new information and might result in rumination and the use of other maladaptive ER strategies. Difficulties inhibiting salient but irrelevant thoughts

and memories would also discourage the use of more effective ER strategies, such as reappraisal.

There is emerging evidence that depression is characterized by deficits in the inhibition of mood-congruent material. The negative-affective-priming task was designed to assess inhibition in the processing of emotional information (Joormann, 2004). This task assesses response times to positive and negative material that participants are instructed to ignore. Dysphoric participants and participants with a history of depressive episodes exhibited reduced inhibition of negative material in their performance on the negative-affective-priming task. Thus, these participants responded faster when a negative target was presented after a to-be-ignored negative distractor on the previous trial. As predicted, no group difference was found for the positive adjectives. It is important that these findings were replicated using a negative-priming task with emotional faces (Goeleven, DeRaedt, Baert, & Koster, 2006).

Negative-priming tasks assess only one aspect of inhibition, that is, the ability to control the access of relevant and irrelevant material to working memory. In addition, there is an ongoing debate about the processes that underlie negative priming (e.g., Neill, Valdes, & Terry, 1995). Whereas these studies have suggested that depression involves difficulties keeping irrelevant emotional information from entering working memory, depression may also be associated with difficulties removing previously relevant negative material from working memory (i.e., updating). Difficulties inhibiting the processing of negative material that was, but is no longer, relevant might explain why people respond to negative mood states and negative life events with recurring, uncontrollable, and unintentional negative thoughts. This hypothesis was tested with a modified Sternberg task that combines a short-term recognition task with instructions to ignore a previously memorized list of words to assess inhibition of irrelevant positive and negative stimuli (Joormann & Gotlib, 2008). Participants diagnosed with major depression exhibited difficulties removing irrelevant negative material from working memory. Specifically, compared with never-depressed control participants, depressed individuals exhibited longer decision latencies to an intrusion probe (i.e., a word from the irrelevant list) than to a new probe (i.e., a completely new word), thereby reflecting the strength of the residual activation of the contents of working memory that were declared to be no longer relevant. This pattern was not found for positive material. Finally, when participants were asked to re-sort material in working memory, diagnosed depressed participants had difficulties manipulating negative material in working memory, and this deficit was associated with self-reported proneness to rumination (Joormann, Levens, & Gotlib, 2011).

Deficits in cognitive control not only may affect a person's ability to discard irrelevant material from working memory, thereby increasing unwanted thoughts, but also may make it difficult to intentionally forget unwanted material. The idea that depression is associated with these control deficits has been tested in directed-forgetting tasks in which participants are instructed to forget previously studied material at some point during the experiment. Later recall is tested, however, for material that was to be remembered and material that was to be forgotten (Bjork & Whitten, 1974). Using positive and negative words, Power, Dalgleish, Claudio, Tata, and Kentish (2000) reported differential directed-forgetting effects for depressed and nondepressed participants. Specifically, the depressed participants exhibited a facilitation effect for negative words after the instruction to forget. It is important to note that the effect was found only when the adjectives were processed in a self-relevant manner. Hertel and Gerstle (2003) demonstrated that, compared with control participants, dysphoric participants recalled more words they were supposed to forget, with a tendency toward increased recall of to-be-forgotten negative words. Moreover, the degree of forgetting was significantly correlated with self-report measures of rumination and unwanted thoughts.

As we have outlined, depression is characterized by deficits in inhibition, updating of working memory, and forgetting. These deficits have also been linked to the use and effectiveness of ER in depression, particularly to an increased tendency to ruminate (Whitmer & Gotlib, 2013). Davis and Nolen-Hoeksema (2000) reported that ruminators made more errors on the Wisconsin Card Sorting Test than did nonruminators. Because the Wisconsin Card Sorting Test measures executive control and cognitive flexibility, these results provide empirical support for the hypothesis that rumination is related to the executive-control component of working memory. In addition, correlations between rumination and deficits in cognitive inhibition have been reported (Joormann, 2006; Joormann & Gotlib, 2010). Difficulty removing negative irrelevant words from working memory was highly correlated with self-reported rumination, as were difficulties manipulating negative material in working memory (Joormann et al., 2011). Finally, participants who scored high on a trait measure of rumination exhibited reduced forgetting of negative material in this task (Joormann & Tran, 2009).

Deficits in cognitive control may also make it difficult to employ attention flexibly, to override interpretive biases, and to use adaptive ER strategies, such as reappraisal. Unfortunately, few studies to date have investigated whether individual differences in cognitive inhibition affect people's ability to use reappraisal. One notable exception showed that, among healthy

individuals, measures of general inhibition, as measured by performance on the Stroop task, were not associated with reappraisal ability (McRae et al., 2012). However, it is plausible that although this study did not find a link between general inhibition and reappraisal effectiveness, deficits in inhibition of negative material are associated with reappraisal. The latter possibility is particularly compelling, given the association between deficits in inhibition of negative stimuli with depression as well as with rumination (Joormann & Gotlib, 2010). This relation, however, remains to be tested.

Although inhibition has not yet been linked to reappraisal, Malooly, Genet, and Siemer (2013) found that, among healthy participants, better ability to shift attentional sets (i.e., shifting ability) was associated with greater downregulation of negative affect using reappraisal. The authors measured shifting ability using an affective-switching task. In this task, individuals were presented with an image and instructed to sort the image according to an affective rule (i.e., sort by valence—happy vs. sad) or a nonaffective rule (i.e., sort by number of people—one or less vs. two or more). Switching was measured by response times to sort the images when the sorting rule switched, that is, the response time to sort an image when the current rule is different from the sorting rule on the previous trial. Malooly et al. found that greater effectiveness of reappraisal during a sad film clip was associated with better performance when switching to the neutral aspects of negative images and when switching to the positive aspects of positive images. Whitmer and Gotlib (2012) also found that depressed individuals who completed a rumination induction exhibited poorer switching ability than did depressed and nondepressed individuals who completed a distraction induction and healthy control individuals who completed a rumination induction. Last, among depressed participants but not healthy control individuals, rumination was associated with reduced ability to update working memory (Meiran, Diamond, Toder, & Nemets, 2011). More research that investigates the relation of cognitive control (inhibition, updating, and shifting) and ER in depression is needed. However, early evidence from clinical and healthy samples has suggested that deficits in cognitive control are associated with induced rumination and poorer reappraisal ability.

Studies recently have started to investigate the possibility of training cognitive control in depression and the effects of this training on ER. Depressed participants, for example, could be trained to forget negative material by practicing active suppression and did particularly well when they were provided with a strategy of how to keep irrelevant material from entering working memory (i.e., by using thought substitutes; Joormann, Hertel, LeMoult, & Gotlib, 2009). Unfortunately, this study did

not investigate whether suppression training affected mood or emotional reactivity to a stressor. In a recent study, Daches and Mor (2013) trained participants high in trait rumination to inhibit negative stimuli. The results from this preliminary study showed improved inhibition but no effect on depression symptoms. Siegle, Thompson, Carter, Steinhauer, and Thase (2007), however, presented preliminary data that demonstrated that a brief intervention targeted at increasing cognitive control in severely depressed outpatients led to significant decreases in both depressive symptoms and rumination. Indeed, work by this group has suggested that training in attentional control may be an effective treatment component for depression (Siegle, Ghinassi, & Thase, 2007). In this training, patients learn to selectively attend to certain sounds while ignoring irrelevant sounds. After 2 weeks of training, patients exhibited decreases in depressive symptoms compared with patients who received treatment as usual (Siegle, Ghinassi, & Thase, 2007). It is notable that the training consisted of short sessions (15 min) that used nonaffective stimuli, such as the sound of birds. Similar results were obtained in a recent study in which researchers examined cognitive-control training in individuals with MDD and individuals with bipolar disorder and found that this training led to reduced depressive symptoms (Preiss, Shatil, Čermáková, Cimermanová, & Ram, 2013). This suggests that cognitive control can be improved with practice and further supports the hypothesis that individual differences in cognitive control may affect ER.

To summarize, MDD has been shown to be associated with biases in attention, interpretation, and memory that affect the processing of negative and positive material. In addition, deficits in cognitive control may interfere with the ability to override biased attention and interpretation, thereby resulting in more frequent use of maladaptive ER strategies and impairments in the use of adaptive strategies. More research is clearly needed, however, that directly links cognitive biases and deficits in cognitive control to ER and emotional responding under stress.

Summary and Future Directions

Given that sustained negative affect and difficulties experiencing positive affect are the hallmark features of depression, basic research on the regulation of affect provides important information for an improved understanding of the etiology, maintenance, and treatment of this debilitating disorder. Our review of the literature provides evidence for the importance of two aspects of ER: individual differences in the habitual use of ER strategies and difficulties in the implementation of adaptive strategies. Specifically, MDD has been associated with frequent use of rumination and less use of reappraisal. Furthermore,

preliminary evidence has shown that depression is associated with difficulties upregulating and maintaining positive affect and attempts to dampen positive emotion. Recent research also has suggested an association with heightened emotion nonacceptance as well as fear of high intensity affect. Results for other ER strategies were either missing or inconsistent, so more work is needed to further clarify the role of, for example, suppression and distraction in MDD. It is important to note that the majority of studies on habitual strategy use have been cross-sectional and relied on self-report only. This is problematic because it is not clear to what extent people can accurately report on their use of strategies, and the self-report of ER may be affected by current mood state. More studies on strategy use in response to a mood manipulation (e.g., Ehring et al., 2010) or in an experience-sampling design are clearly needed.

Fewer studies have been conducted to examine difficulties in the implementation of adaptive strategies, and this area clearly should be a focus of future research on ER in this disorder. Initial findings have suggested that whereas depressed participants can use distraction effectively, reappraisal is more challenging. Studies have suggested that depression is associated with difficulties using positive material to offset negative affect. Whereas some studies have suggested that these difficulties in strategy implementation do not just characterize currently depressed participants, more research is needed on the question whether we find similar deficits prior to the first episode of the disorder and whether these difficulties predict future episodes of MDD. Specifically, longitudinal studies in high-risk samples are needed to answer the important question whether these difficulties in ER are indeed a risk factor for the onset of the disorder or simply an epiphenomenon.

Most studies on ER have focused on the downregulation of negative affect, but our review of the literature shows that the processing of mood-incongruent material and the regulation of positive affect may also play an important role in MDD. Our review of the literature shows that difficulties enhancing positive affect and a tendency to dampen positive emotions characterize depression. In addition, recent studies have demonstrated that depressed participants try to avoid not only intense negative affect but also intense positive affect. In addition, studies on mood-incongruent recall have indicated that even though depressed participants recall positive memories, they have difficulties using these memories to repair negative affect. Taken together, the downregulation of negative affect seems a very narrow focus. Future research should pay more attention to the regulation of positive affect in depression. A focus on responses to positive affect could also improve current depression treatment. Indeed, in a recent intervention study,

McMakin, Siegle, and Shirk (2011) included a module on enhancing and maintaining positive affect and found greater improvements in depression symptoms.

We further examined cognitive processes that may underlie difficulties in ER. Research on cognitive biases and deficits that are associated with MDD may help to better understand maladaptive ER and difficulties implementing adaptive ER strategies. Indeed, biased cognition in conjunction with deficits in cognitive control may guide emotional responding in depression and explain difficulties overriding maladaptive responding with the use of more adaptive ER strategies (see Fig. 1). Biased processing in depression may affect the initial appraisal of an emotion-eliciting event and result in automatic maladaptive responses (e.g., rumination). Cognitive-control deficits may affect strategies such as distraction and reappraisal. Whereas both strategies require cognitive control, reappraisal is frequently seen as the more effortful strategy, which may explain why distraction works but reappraisal may fail in depressed participants. Timing over the course of an emotional response may also be a key variable that influences the effectiveness of reappraisal. Reappraisal, initiated once an emotional response is under way (often referred to as "on-line reappraisal"), appears to be more difficult to implement and more cognitively taxing than anticipatory reappraisal or other strategies (e.g., distraction) implemented at early processing stages of an emotional episode (Sheppes, Catran, & Meiran, 2009; Sheppes & Meiran, 2007; Urry, 2009). Indeed, recent work by Sheppes, Scheibe, Suri, and Gross (2011) has shown that reappraisal becomes more difficult if affect is intense and that nondisordered participants prefer to use distraction over reappraisal when they deal with intense emotions. In addition, Sheppes and Gross (2011) have pointed out that engaging ER strategies at a later point in the emotion episode typically results in the regulation of more intense affect. Despite the increased difficulty, on-line reappraisal may be particularly important to examine in MDD. Given the persistent negative affect characterizing this disorder, individuals with depression likely need to implement ER strategies in response to an existing emotional state of relatively high intensity. If implemented on-line, reappraisal probably requires levels of cognitive control that may not be available to people with affective disorders. This represents an important area that needs further research.

Whereas this article focuses on the role of cognitive processes and ER difficulties in depression, it is important to keep in mind that many of the discussed constructs probably cut across different disorders and are not specific to depression. As described in the previous sections, for example, the use of maladaptive strategies, such as rumination, has been shown to play a role in many internalizing and even some externalizing disorders. Ruscio,

Seitchik, Gentes, Jones, and Hallion (2011), for example, found that perseverative thought, a construct resembling rumination, was not unique to depression but, rather, characterized heightened emotional reactivity across both MDD and generalized anxiety disorder. Whereas much research has been done on the role of rumination across disorders, more work needs to be done on other ER strategies, such as reappraisal and suppression. In one of the first studies to include internalizing and externalizing disorders, Aldao et al. (2010) conducted a meta-analysis in which they examined the habitual use of six ER strategies across four psychopathology groups (anxiety, depression, eating, and substance-use disorders). The authors found that all psychopathologies were associated with greater use of maladaptive ER strategies and less use of adaptive ER strategies. Nevertheless, depression and anxiety were more strongly linked to increased use of rumination and avoidance of emotion, as well as decreased use of reappraisal, than were eating and substance-use disorders. These results imply that ER difficulties may represent an underlying transdiagnostic maintenance factor but that the role of these difficulties may be more prominent in internalizing disorders, such as depression and anxiety.

In this context, it also seems important to examine more closely the relation of specific ER strategies to other individual difference constructs, such as neuroticism, impulsivity, and extraversion. A close link between these constructs and the use of ER strategies could explain why difficulties with ER can be viewed as a transdiagnostic risk factor. Similarly, whereas there is some evidence of specificity of cognitive biases, cognitive-control deficits have been proposed as another important transdiagnostic risk factor (for reviews, see Joormann et al., 2010; Mathews & MacLeod, 2005). In sum, cognitive biases and ER difficulties are present across many psychological disorders. Nevertheless, there is some evidence that their role is especially important in the conceptualization of the etiology and maintenance of internalizing disorders, such as MDD.

Finally, there are some important treatment implications that warrant discussion. Cognitive-behavioral therapy has focused on the identification and modification of maladaptive cognitions, and recent additions to this intervention have started to focus more systematically on training reappraisal skills and preventing emotional avoidance (Campbell-Sills & Barlow, 2007). Given the earlier discussion of cognitive processes that underlie ER, recent studies on cognitive-bias modification and cognitive-control training seem particularly promising. Most of these studies have been conducted with samples composed of patients with anxiety disorders, but at least two recent studies have provided encouraging data that a training aimed at modifying attention biases may also apply to depression (Baert et al., 2011; Wells & Beevers, 2010). Other studies have focused on modifying memory and interpretation biases, but these trainings have not yet been tested with depressed participants (Raes, Williams, & Hermans, 2009). Of special importance is a recent study that showed improvement in cognitive control after a training of executive control. Specifically, cognitive-control training yielded transferable gains to improved control over affective stimuli and ER (Schweizer, Grahn, Hampshire, Mobbs, & Dalgleish, 2013; Schweizer, Hampshire, & Dalgleish, 2011). A similar training showed effects on thought control over intrusive memories (Bomyea & Amir, 2011). Whereas cognitive-bias modification provides a unique method to examine the causal role of cognition in psychopathology and thereby represents an exciting area for potential intervention, future research is needed to understand the mechanisms of how bias modification is effective and moderators that examine when it works.

This review showcases the enormous strides that research on ER in psychological disorders has made over the years. Nevertheless, there are important conceptual and methodological questions that remain unanswered. For example, research on habitual strategy use often does not consider the situations in which individuals use these strategies. Research has shown, however, that strategy effectiveness can vary depending on the circumstances in which strategies are used. Webb et al. (2012) reported, for example, that reappraisal of an emotion-eliciting event was more effective at reducing negative affect than was reappraisal of the emotion itself. Similarly, Troy, Shallcross, and Mauss (2013) found that reappraisal effectively regulated affect in responses to uncontrollable stressors but appeared to be maladaptive in responses to controllable stressors (i.e., when the situation can be changed). Greater consideration of the contexts in which people use different ER strategies is recommended for future research that investigates ER in psychopathology. A second limitation of the extant literature is the focus on individual ER strategies rather than comprehensive ER profiles. As highlighted earlier, Aldao and Nolen-Hoeksema (2012) found that the relation between psychopathology and ER strategy use can vary depending on which other ER strategies are habitually used. Thus, studying an ER strategy in isolation likely dilutes its effectiveness and relation to psychopathology.

Consistent with this observation is Bonanno and Burton's (2013) recent suggestion that successful ER likely depends on the flexibility to adopt an ER strategy that best fits a given situation. Very few studies on affective disorders have assessed more than one strategy, and it is currently not known whether the primary problem in ER in these disorders is inflexibility instead of habitual use of a specific strategy or difficulties implementing a strategy.

Therefore, understanding how ER strategies can work together, rather than which one is most effective in isolation, represents an important avenue for future research.

Author Contributions

J. Joormann and W. M. Vanderlind worked together on the concept of the article. J. Joormann wrote a first draft and both authors conducted literature searches. W. M. Vanderlind provided edits of the draft. All authors approved the final version.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

References

Aldao, A., & Nolen-Hoeksema, S. (2012). When are adaptive strategies most predictive of psychopathology? *Journal of Abnormal Psychology*, *121*, 276–281. doi:10.1037/a0023598

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*, 217–237. doi:10.1016/j.cpr.2009.11.004

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Baert, S., Koster, E. H. W., & De Raedt, R. (2011). Modification of information processing biases in emotional disorders: Clinically relevant developments in experimental psychopathology. *International Journal of Cognitive Therapy*, *4*, 208–222. doi:10.1521/ijct.2011.4.2.208

Beard, C., & Amir, N. (2008). A multi-session interpretation modification program: Changes in interpretation and social anxiety symptoms. *Behaviour Research and Therapy*, *46*, 1135–1141. doi:10.1016/j.brat.2008.05.012

Beblo, T., Fernando, S., Klocke, S., Griepenstroh, J., Aschenbrenner, S., & Driessen, M. (2012). Increased suppression of negative and positive emotions in major depression. *Journal of Affective Disorders*, *141*, 474–479. doi:10.1016/j.jad.2012.03.019

Beck, A. T. (1967). *Depression: Clinical, experimental, and theoretical aspects*. New York, NY: Harper & Row.

Beck, A. T., Rush, A. J., Shaw, B. F., & Emery, G. (1979). *Cognitive therapy of depression: A treatment manual*. New York, NY: Guilford Press.

Beevers, C. G., & Carver, C. S. (2003). Attentional bias and mood persistence as prospective predictors of dysphoria. *Cognitive Therapy and Research*, *27*, 619–637. doi:10.1023/A:1026347610928

Bisson, M. A. S., & Sears, C. R. (2007). The effect of depressed mood on the interpretation of ambiguity, with and without negative mood induction. *Cognition & Emotion*, *21*, 614–645. doi:10.1080/02699930600750715

Bjork, R. A., & Whitten, W. B. (1974). Recency-sensitive retrieval processes in long-term free recall. *Cognitive Psychology*, *6*, 173–189. doi:10.1016/0010-0285(74)90009-7

Bomyea, J., & Amir, N. (2011). The effect of an executive functioning training program on working memory capacity and intrusive thoughts. *Cognitive Therapy and Research*, *35*, 529–535. doi:10.1007/s10608-011-9369-8

Bonanno, G. A., & Burton, C. L. (2013). Regulatory flexibility: An individual differences perspective on coping and emotion regulation. *Perspectives on Psychological Science*, *8*, 591–612. doi:10.1177/1745691613504116

Bradley, B. P., Mogg, K., & Lee, S. C. (1997). Attentional biases for negative information in induced and naturally occurring dysphoria. *Behaviour Research and Therapy*, *35*, 911–927. doi:10.1016/S0005-7967(97)00053-3

Butler, G., & Mathews, A. (1983). Cognitive processes in anxiety. *Advances in Behaviour Research and Therapy*, *5*, 51–62. doi:10.1016/0146-6402(83)90015-2

Campbell-Sills, L., & Barlow, D. H. (2007). Incorporating emotion regulation into conceptualizations and treatments of anxiety and mood disorders. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 542–559). New York, NY: Guilford Press.

Campbell-Sills, L., Barlow, D. H., Brown, T. A., & Hofmann, S. G. (2006). Acceptability and suppression of negative emotion in anxiety and mood disorders. *Emotion*, *6*, 587–595. doi:10.1037/1528-3542.6.4.587

Caseras, X., Garner, M., Bradley, B. P., & Mogg, K. (2007). Biases in visual orienting to negative and positive scenes in dysphoria: An eye movement study. *Journal of Abnormal Psychology*, *116*, 491–497. doi:10.1037/0021-843X.116.3.491

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology: General*, *132*, 310–324. doi:10.1037/0096-3445.132.2.310

Clasen, P. C., Wells, T. T., Ellis, A. J., & Beevers, C. G. (2013). Attentional biases and the persistence of sad mood in major depressive disorder. *Journal of Abnormal Psychology*, *122*, 74–85. doi:10.1037/a0029211

Compton, R. J., Heller, W., Banich, M. T., Palmieri, P. A., & Miller, G. A. (2000). Responding to threat: Hemispheric asymmetries and interhemispheric division of input. *Neuropsychology*, *14*, 254–264. doi:10.1037/0894-4105.14.2.254

Cowan, N. (1999). An embedded-processes model of working memory. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62–101). New York, NY: Cambridge University Press.

Cowden Hindash, A. H., & Amir, N. (2012). Negative interpretation bias in individuals with depressive symptoms. *Cognitive Therapy and Research*, *36*, 502–511. doi:10.1007/s10608-011-9397-4

Daches, S., & Mor, N. (2013). Training ruminators to inhibit negative information: A preliminary report. *Cognitive Therapy and Research*, *38*, 160–171. doi:10.1007/s10608-013-9585-5

Dalgleish, T., Spinks, H., Yiend, J., & Kuyken, W. (2001). Autobiographical memory style in seasonal affective disorder and its relationship to future symptom remission. *Journal of Abnormal Psychology*, *110*, 335–340. doi:10.1037/0021-843X.110.2.335

D'Avanzato, C., Joormann, J., Siemer, M., & Gotlib, I. H. (2013). Emotion regulation in depression and anxiety: Examining diagnostic specificity and stability. *Cognitive Therapy and Research*, *37*, 968–980. doi:10.1007/s10608-013-9537-0

Davis, R. N., & Nolen-Hoeksema, S. (2000). Cognitive inflexibility among ruminators and nonruminators. *Cognitive Therapy and Research*, *24*, 699–711. doi:10.1023/A:1005591412406

Dearing, K. F., & Gotlib, I. H. (2009). Interpretation of ambiguous information in girls at risk for depression. *Journal of Abnormal Child Psychology*, *37*, 79–91. doi:10.1007/s10802-008-9259-z

Demenescu, L. R., Renken, R., Kortekaas, R., van Tol, M.-J., Marsman, J. B. C., van Buchem, M. A., . . . Aleman, A. (2011). Neural correlates of perception of emotional facial expression in out-patients with mild-to-moderate depression and anxiety: A multicenter fMRI study. *Psychological Medicine*, *41*, 2253–2264. doi:10.1017/S0033291711000596

Dillon, D., & Pizzagalli, D. (2013). Evidence of successful modulation of brain activation and subjective experience during reappraisal of negative emotion in unmedicated depression. *Psychiatry Research: Neuroimaging*, *212*, 99–107. doi:10.1016/j.pscychresns.2013.01.001

Donaldson, C., Lam, D., & Mathews, A. (2007). Rumination and attention in major depression. *Behaviour Research and Therapy*, *45*, 2664–2678. doi:10.1016/j.brat.2007.07.002

Drabant, E. M., McRae, K., Manuck, S. B., Hariri, A. R., & Gross, J. J. (2009). Individual differences in typical reappraisal use predict amygdala and prefrontal responses. *Biological Psychiatry*, *65*, 367–373. doi:10.1016/j.biopsych.2008.09.007

Ehring, T., Tuschen-Caffier, B., Schnülle, J., Fischer, S., & Gross, J. J. (2010). Emotion regulation and vulnerability to depression: Spontaneous versus instructed use of emotion suppression and reappraisal. *Emotion*, *10*, 563–572. doi:10.1037/a0019010

Eizenman, M., Yu, L. H., Grupp, L., Eizenman, E., Ellenbogen, M., Gemar, M., & Levitan, R. D. (2003). A naturalistic visual scanning approach to assess selective attention in major depressive disorder. *Psychiatry Research*, *118*, 117–128. doi:10.1016/S0165-1781(03)00068-4

Ellenbogen, M. A., Schwartzman, A. E., Stewart, J., & Walker, C. (2002). Stress and selective attention: The interplay of mood, cortisol levels, and emotional information processing. *Psychophysiology*, *39*, 723–732. doi:10.1111/1469-8986.3960723

Ellis, A. J., Vanderlind, W. M., & Beevers, C. G. (2012). Enhanced anger reactivity and reduced distress tolerance in major depressive disorder. *Cognitive Therapy and Research*, *37*, 498–509. doi:10.1007/s106080129494z

Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: A latent-variable analysis. *Journal of Experimental Psychology: General*, *133*, 101–135. doi:10.1037/0096-3445.133.1.101

Garnefski, N., & Kraaij, V. (2006). Cognitive Emotion Regulation Questionnaire: Development of a short 18-item version (CERQ-Short). *Personality and Individual Differences*, *41*, 1045–1053. doi:10.1016/j.paid.2006.04.010

Garnefski, N., Legerstee, J., Kraaij, V., van den Kommer, T., & Teerds, J. (2002). Cognitive coping strategies and symptoms of depression and anxiety: A comparison between adolescents and adults. *Journal of Adolescence*, *25*, 603–611. doi:10.1006/jado.2002.0507

Goeleven, E., De Raedt, R., Baert, S., & Koster, E. H. W. (2006). Deficient inhibition of emotional information in depression. *Journal of Affective Disorders*, *93*, 149–157. doi:10.1016/j.jad.2006.03.007

Gross, J. J. (1998). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, *74*, 224–237. doi:10.1037/0022-3514.74.1.224

Gross, J. J. (2014). Emotion regulation: Conceptual and empirical foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (2nd ed., pp. 3–20). New York, NY: Guilford Press.

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*, 348–362. doi:10.1037/0022-3514.85.2.348

Hasher, L., Zacks, R. T., & May, C. P. (1999). Inhibitory control, circadian arousal, and age. In D. Gopher & A. Koriat (Eds.), *Attention and performance XVII: Cognitive regulation of performance: Interaction of theory and application* (pp. 653–675). Cambridge, MA: MIT Press.

Heller, A. S., Johnstone, T., Shackman, A. J., Light, S. N., Peterson, M. J., Kolden, G. G., . . . Davidson, R. J. (2009). Reduced capacity to sustain positive emotion in major depression reflects diminished maintenance of fronto-striatal brain activation. *Proceedings of the National Academy of Sciences, USA*, *106*, 22445–22450. doi:10.1073/pnas.0910651106

Hertel, P. T. (1997). On the contributions of deficient cognitive control to memory impairments in depression. *Cognition & Emotion*, *11*, 569–583. doi:10.1080/026999397379890a

Hertel, P. (2004). Memory for emotional and nonemotional events in depression: A question of habit? In D. Reisberg & P. Hertel (Eds.), *Memory and emotion* (pp. 186–216). New York, NY: Oxford University Press.

Hertel, P. T., & Gerstle, M. (2003). Depressive deficits in forgetting. *Psychological Science*, *14*, 573–578. doi:10.1046/j.0956-7976.2003.psci_1467.x

John, O. P., & Gross, J. J. (2004). Healthy and unhealthy emotion regulation: Personality processes, individual differences, and life span development. *Journal of Personality*, *72*, 1301–1333. doi:10.1111/j.1467-6494.2004.00298.x

Johnson, D. R. (2009). Emotional attention set-shifting and its relationship to anxiety and emotion regulation. *Emotion*, *9*, 681–690. doi:10.1037/a0017095

Johnstone, T., van Reekum, C. M., Urry, H. L., Kalin, N. H., & Davidson, R. J. (2007). Failure to regulate: Counterproductive recruitment of top-down prefrontal-subcortical circuitry in major depression. *Journal of Neuroscience*, *27*, 8877–8884. doi:10.1523/JNEUROSCI.2063-07.2007

Joormann, J. (2004). Attentional bias in dysphoria: The role of inhibitory processes. *Cognition & Emotion*, *18*, 125–147. doi:10.1080/02699930244000480

Joormann, J. (2005). Inhibition, rumination, and mood regulation in depression. In R. W. Engle, G. Sedek, U. von Hecker, & D. N. McIntosh (Eds.), *Cognitive limitations in aging and psychopathology* (pp. 275–312). New York, NY: Cambridge University Press.

Joormann, J. (2006). Differential effects of rumination and dysphoria on the inhibition of irrelevant emotional material: Evidence from a negative priming task. *Cognitive Therapy and Research*, *30*, 149–160. doi:10.1007/s10608-006-9035-8

Joormann, J. (2010). Cognitive inhibition and emotion regulation in depression. *Current Directions in Psychological Science*, *19*, 161–166. doi:10.1177/0963721410370293

Joormann, J., Cooney, R. E., Henry, M. L., & Gotlib, I. H. (2012). Neural correlates of automatic mood regulation in girls at high risk for depression. *Journal of Abnormal Psychology*, *121*, 61–72. doi:10.1037/a0025294

Joormann, J., & Gotlib, I. H. (2007). Selective attention to emotional faces following recovery from depression. *Journal of Abnormal Psychology*, *116*, 80–85. doi:10.1037/0021-843X.116.1.80

Joormann, J., & Gotlib, I. H. (2008). Updating the contents of working memory in depression: Interference from irrelevant negative material. *Journal of Abnormal Psychology*, *117*, 182–192. doi:10.1037/0021-843X.117.1.182

Joormann, J., & Gotlib, I. H. (2010). Emotion regulation in depression: Relation to cognitive inhibition. *Cognition & Emotion*, *24*, 281–298. doi:10.1080/02699930903407948

Joormann, J., Hertel, P. T., LeMoult, J., & Gotlib, I. H. (2009). Training forgetting of negative material in depression. *Journal of Abnormal Psychology*, *118*, 34–43. doi:10.1037/a0013794

Joormann, J., Levens, S., & Gotlib, I. H. (2011). Sticky thoughts: Depression and rumination are associated with difficulties manipulating emotional material in working memory. *Psychological Science*, *22*, 979–983. doi:10.1177/0956797611415539

Joormann, J., & Siemer, M. (2004). Memory accessibility, mood regulation, and dysphoria: Difficulties in repairing sad mood with happy memories? *Journal of Abnormal Psychology*, *113*, 179–188. doi:10.1037/0021-843X.113.2.179

Joormann, J., & Siemer, M. (2014). Emotion regulation in mood disorders. In J. J. Gross (Ed.), *Handbook of emotion regulation* (2nd ed., pp. 3–20). New York, NY: Guilford Press.

Joormann, J., Siemer, M., & Gotlib, I. H. (2007). Mood regulation in depression: Differential effects of distraction and recall of happy memories on sad mood. *Journal of Abnormal Psychology*, *116*, 484–490. doi:10.1037/0021-843X.116.3.484

Joormann, J., Talbot, L., & Gotlib, I. H. (2007). Biased processing of emotional information in girls at risk for depression. *Journal of Abnormal Psychology*, *116*, 135–143. doi:10.1037/0021-843X.116.1.135

Joormann, J., & Tran, T. (2009). Rumination and intentional forgetting of emotional material. *Cognition & Emotion*, *23*, 1233–1246. doi:10.1080/02699930802416735

Joormann, J., Yoon, K., & Siemer, M. (2010). Cognition and emotion regulation. In A. M. Kring & D. M. Sloan (Eds.), *Emotion regulation and psychopathology: A transdiagnostic approach to etiology and treatment* (pp. 174–203). New York, NY: Guilford Press.

Kanske, P., Heissler, J., Schönfelder, S., & Wessa, M. (2012). Neural correlates of emotion regulation deficits in remitted depression: The influence of regulation strategy, habitual regulation use, and emotional valence. *NeuroImage*, *61*, 686–693. doi:10.1016/j.neuroimage.2012.03.089

Kellough, J. L., Beevers, C. G., Ellis, A. J., & Wells, T. T. (2008). Time course of selective attention in clinically depressed young adults: An eye-tracking study. *Behaviour Research and Therapy*, *46*, 1238–1243. doi:10.1016/j.brat.2008.07.004

Kessler, R. C., & Wang, P. S. (2009). Epidemiology of depression. In I. H. Gotlib & C. L. Hammen (Eds.), *Handbook of depression* (2nd ed., pp. 5–22). New York, NY: Guilford Press.

Koster, E. W., De Lissnyder, E., Derakshan, N., & De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review*, *31*, 138–145. doi:10.1016/j.cpr.2010.08.005

Koster, E. H. W., De Raedt, R., Goeleven, E., Franck, E., & Crombez, G. (2005). Mood-congruent attentional bias in dysphoria: Maintained attention to and impaired disengagement from negative information. *Emotion*, *5*, 446–455. doi:10.1037/1528-3542.5.4.446

Larsen, J. K., Vermulst, A. A., Geenen, R., van Middendorp, H., English, T., Gross, J. J., . . . Engels, R. C. M. E. (2013). Emotion regulation in adolescence: A prospective study of expressive suppression and depressive symptoms. *Journal of Early Adolescence*, *33*, 184–200. doi:10.1177/0272431611432712

Lawson, C., & MacLeod, C. (1999). Depression and the interpretation of ambiguity. *Behaviour Research and Therapy*, *37*, 463–474. doi:10.1016/S0005-7967(98)00131-4

Lawson, C., MacLeod, C., & Hammond, G. (2002). Interpretation revealed in the blink of an eye: Depressive bias in the resolution of ambiguity. *Journal of Abnormal Psychology*, *111*, 321–328. doi:10.1037/0021-843X.111.2.321

Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York, NY: McGraw-Hill.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York, NY: Springer.

Lim, S., & Kim, J. (2005). Cognitive processing of emotional information in depression, panic, and somatoform disorder. *Journal of Abnormal Psychology*, *114*, 50–61. doi:10.1037/0021-843X.114.1.50

Liverant, G. I., Brown, T. A., Barlow, D. H., & Roemer, L. (2008). Emotion regulation in unipolar depression: The effects of acceptance and suppression of subjective emotional experience on the intensity and duration of sadness and negative affect. *Behaviour Research and Therapy*, *46*, 1201–1209. doi:10.1016/j.brat.2008.08.001

Liverant, G. I., Kamholz, B. W., Sloan, D. M., & Brown, T. A. (2011). Rumination in clinical depression: A type of emotional suppression? *Cognitive Therapy and Research*, *35*, 253–265. doi:10.1007/s10608-010-9304-4

Lyubomirsky, S., & Nolen-Hoeksema, S. (1993). Self-perpetuating properties of dysphoric rumination. *Journal of Personality and Social Psychology*, *65*, 339–349. doi:10.1037/0022-3514.65.2.339

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem solving. *Journal of Personality and Social Psychology*, *69*, 176–190. doi:10.1037/0022-3514.69.1.176

Mackintosh, B., Mathews, A., Yiend, J., Ridgeway, V., & Cook, E. (2006). Induced biases in emotional interpretation influence stress vulnerability and endure despite changes in

context. *Behavior Therapy*, *37*, 209–222. doi:10.1016/j.beth.2006.03.001

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology*, *111*, 107–123. doi:0.1037/0021-843X.111.1.107

Malooly, A. M., Genet, J. J., & Siemer, M. (2013). Individual differences in reappraisal effectiveness: The role of affective flexibility. *Emotion*, *13*, 302–313. doi:10.1037/a0029980

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*, 602–615. doi:10.1037/0021-843X.109.4.602

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167–195. doi:10.1146/annurev.clinpsy.1.102803.143916

Matt, G. E., Vazquez, C., & Campbell, W. K. (1992). Mood-congruent recall of affectively toned stimuli: A meta-analytic review. *Clinical Psychology Review*, *12*, 227–255. doi:10.1016/0272-7358(92)90116-P

McEvoy, P. M., Watson, H., Watkins, E. R., & Nathan, P. (2013). The relationship between worry, rumination, and comorbidity: Evidence for repetitive negative thinking as a transdiagnostic construct. *Journal of Affective Disorders*, *151*, 313–320. doi:10.1016/j.jad.2013.06.014

McMakin, D. L., Siegle, G. J., & Shirk, S. R. (2011). Positive affect stimulation and sustainment (PASS) module for depressed mood: A preliminary investigation of treatment-related effects. *Cognitive Therapy and Research*, 35, 217–226. doi:10.1007/s10608-010-9311-5

McRae, K., Jacobs, S. E., Ray, R. D., John, O. P., & Gross, J. J. (2012). Individual differences in reappraisal ability: Links to reappraisal frequency, well-being, and cognitive control. *Journal of Research in Personality*, *46*, 2–7. doi:10.1016/j.jrp.2011.10.003

Meiran, N., Diamond, G. M., Toder, D., & Nemets, B. (2011). Cognitive rigidity in unipolar depression and obsessive compulsive disorder: Examination of task switching, Stroop, working memory updating and post-conflict adaption. *Psychiatry Research*, *185*, 149–156. doi:10.1016/j.psychres.2010.04.044

Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science*, *21*, 8–14. doi:10.1177/0963721411429458

Miyake, A., & Shah, P. (1999). *Models of working memory: Mechanisms of active maintenance and executive control*. New York, NY: Cambridge University Press.

Mogg, K., Bradley, B. P., Williams, R., & Mathews, A. (1993). Subliminal processing of emotional information in anxiety and depression. *Journal of Abnormal Psychology*, *102*, 304–311. doi:10.1037/0021-843X.102.2.304

Mogoaşe, C., Brăilean, A., & David, D. (2013). Can concreteness training alone reduce depressive symptoms? A randomized pilot study using an Internet-delivered protocol. *Cognitive Therapy and Research*, *37*, 704–712. doi:10.1007/s10608-012-9514-z

Neill, W., Valdes, L. A., & Terry, K. M. (1995). Selective attention and the inhibitory control of cognition. In F. N. Dempster &

C. J. Brainerd (Eds.), *Interference and inhibition in cognition* (pp. 207–261). San Diego, CA: Academic Press.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology*, *100*, 569–582. doi:10.1037/0021-843X.100.4.569

Nolen-Hoeksema, S. (2000). Further evidence for the role of psychosocial factors in depression chronicity. *Clinical Psychology: Science and Practice*, *7*, 224–227. doi:10.1093/clipsy/7.2.224

Nolen-Hoeksema, S., Stice, E., Wade, E., & Bohon, C. (2007). Reciprocal relations between rumination and bulimic, substance abuse, and depressive symptoms in female adolescents. *Journal of Abnormal Psychology*, *116*, 198–207. doi:10.1037/0021-843X.116.1.198

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*, 400–424. doi:10.1111/j.1745-6924.2008.00088.x

Olatunji, B. O., Naragon-Gainey, K., & Wolitzky-Taylor, K. B. (2013). Specificity of rumination in anxiety and depression: A multimodal meta-analysis. *Clinical Psychology: Science and Practice*, *20*, 225–257. doi:10.1111/cpsp.12037

Papageorgiou, C., & Wells, A. (2001). Positive beliefs about depressive rumination: Development and preliminary validation of a self-report scale. *Behavior Therapy*, *32*, 13–26. doi:10.1016/S0005-7894(01)80041-1

Power, M. J., Dalgleish, T., Claudio, V., Tata, P., & Kentish, J. (2000). The directed forgetting task: Application to emotionally valent material. *Journal of Affective Disorders*, *57*, 147–157. doi:10.1016/S0165-0327(99)00084-1

Preiss, M., Shatil, E., Čermáková, R., Cimermanová, D., & Ram, I. (2013). Personalized cognitive training in unipolar and bipolar disorder: A study of cognitive functioning. *Frontiers in Human Neuroscience*, 7(108). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3651957/

Raes, F., Smets, J., Nelis, S., & Schoofs, H. (2012). Dampening of positive affect prospectively predicts depressive symptoms in non-clinical samples. *Cognition & Emotion*, *26*, 75–82. doi:10.1080/02699931.2011.555474

Raes, F., Williams, J. M. G., & Hermans, D. (2009). Reducing cognitive vulnerability to depression: A preliminary investigation of memory specificity training (MEST) in inpatients with depressive symptomatology. *Journal of Behavior Therapy and Experimental Psychiatry*, *40*, 24–38. doi:10.1016/j.jbtep.2008.03.001

Ray, R. D., McRae, K., Ochsner, K. N., & Gross, J. J. (2010). Cognitive reappraisal of negative affect: Converging evidence from EMG and self-report. *Emotion*, *10*, 587–592. doi:10.1037/a0019015

Richards, J. M., & Gross, J. J. (2000). Emotion regulation and memory: The cognitive costs of keeping one's cool. *Journal of Personality and Social Psychology*, *79*, 410–424. doi:10.1037/0022-3514.79.3.410

Rinck, M., & Becker, E. S. (2005). A comparison of attentional biases and memory biases in women with social phobia and major depression. *Journal of Abnormal Psychology*, *114*, 62–74. doi:10.1037/0021-843X.114.1.62

Ruscio, A. M., Seitchik, A. E., Gentes, E. L., Jones, J. D., & Hallion, L. S. (2011). Perseverative thought: A robust predictor of response to emotional challenge in generalized anxiety

disorder and major depressive disorder. *Behaviour Research and Therapy*, *49*, 867–874. doi:10.1016/j.brat.2011.10.001

Rusting, C. L., & DeHart, T. (2000). Retrieving positive memories to regulate negative mood: Consequences for mood-congruent memory. *Journal of Personality and Social Psychology*, *78*, 737–752. doi:10.1037/0022-3514.78.4.737

Sanchez, A., Vazquez, C., Marker, C., LeMoult, J., & Joormann, J. (2013). Disengagement predicts stress recovery in depression: An eye-tracking study. *Journal of Abnormal Psychology*, *122*, 303–313. doi:10.1037/a0031529

Schweizer, S., Grahn, J., Hampshire, A., Mobbs, D., & Dalgleish, T. (2013). Training the emotional brain: Improving affective control through emotional working memory training. *Journal of Neuroscience*, *33*, 5301–5311. doi:10.1523/JNEUROSCI.2593-12.2013

Schweizer, S., Hampshire, A., & Dalgleish, T. (2011). Extending brain-training to the affective domain: Increasing cognitive and affective executive control through emotional working memory training. *PLoS ONE*, *6*(9), e24372. Retrieved from http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0024372

Sears, C. R., Newman, K. R., Ference, J. D., & Thomas, C. L. (2011). Attention to emotional images in previously depressed individuals: An eye-tracking study. *Cognitive Therapy and Research*, *35*, 517–528. doi:10.1007/s10608-011-9396-5

Sheline, Y. I., Barch, D. M., Donnelly, J. M., Ollinger, J. M., Snyder, A. Z., & Mintun, M. A. (2001). Increased amygdala response to masked emotional faces in depressed subjects resolves with antidepressant treatment: An fMRI study. *Biological Psychiatry*, *50*, 651–658. doi:10.1016/S0006-3223(01)01263-X

Sheppes, G., Catran, E., & Meiran, N. (2009). Reappraisal (but not distraction) is going to make you sweat: Physiological evidence for self-control effort. *International Journal of Psychophysiology*, *71*, 91–96. doi:10.1016/j.ijpsycho.2008.06.006

Sheppes, G., & Gross, J. J. (2011). Is timing everything? Temporal considerations in emotion regulation. *Personality and Social Psychology Review*, *15*, 319–331. doi:10.1177/1088868310395778

Sheppes, G., & Meiran, N. (2007). Better late than never? On the dynamics of online regulation of sadness using distraction and cognitive reappraisal. *Personality and Social Psychology Bulletin*, *33*, 1518–1532. doi:10.1177/0146167207305537

Sheppes, G., Scheibe, S., Suri, G., & Gross, J. J. (2011). Emotion-regulation choice. *Psychological Science*, *22*, 1391–1396. doi:10.1177/0956797611418350

Siegle, G. J., Ghinassi, F., & Thase, M. E. (2007). Neurobehavioral therapies in the 21st century: Summary of an emerging field and an extended example of cognitive control training for depression. *Cognitive Therapy and Research*, *31*, 235–262. doi:10.1007/s10608-006-9118-6

Siegle, G. J., Thompson, W., Carter, C. S., Steinhauer, S. R., & Thase, M. E. (2007). Increased amygdala and decreased dorsolateral prefrontal BOLD responses in unipolar depression: Related and independent features. *Biological Psychiatry*, *61*, 198–209. doi:10.1016/j.biopsych.2006.05.048

Siemer, M. (2005). Mood-congruent cognitions constitute mood experience. *Emotion*, *5*, 296–308. doi:10.1037/1528-3542.5.3.296

Siemer, M., & Reisenzein, R. (2007). The process of emotion inference. *Emotion*, *7*, 1–20. doi:10.1037/1528-3542.7.1.1

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *State-Trait Anxiety Inventory: STAI*. Palo Alto, CA: Consulting Psychologists Press.

Stewart, J. G., Mazurka, R., Bond, L., Wynne-Edwards, K. E., & Harkness, K. L. (2013). Rumination and impaired cortisol recovery following a social stressor in adolescent depression. *Journal of Abnormal Child Psychology*, *41*, 1015–1026. doi:10.1007/s10802-013-9740-1

Teachman, B., Joormann, J., Steinman, S. A., & Gotlib, I. H. (2012). Automaticity in anxiety and depression. *Clinical Psychology Review*, *32*, 575–603. doi:10.1016/j.cpr.2012.06.004

Teasdale, J. D. (1988). Cognitive vulnerability to persistent depression. *Cognition & Emotion*, *2*, 247–274. doi:10.1080/02699938808410927

Thomas, E. J., Elliot, R., McKie, S., Arnone, D., Downey, D., Juhasz, G., . . . Anderson, I. M. (2011). Interaction between a history of depression and rumination on neural response to emotional faces. *Psychological Medicine*, *41*, 1845–1855. doi:10.1017/S0033291711000043

Troy, A. S., Shallcross, A. J., & Mauss, I. B. (2013). A person-by-situation approach to emotion regulation: Cognitive reappraisal can either help or hurt, depending on the context. *Psychological Science*, *24*, 2505–2514. doi:10.1177/0956797613496434

Troy, A. S., Wilhelm, F. H., Shallcross, A. J., & Mauss, I. B. (2010). Seeing the silver lining: Cognitive reappraisal ability moderates the relationship between stress and depressive symptoms. *Emotion*, *10*, 783–795. doi:10.1037/a0020262

Urry, H. L. (2009). Using reappraisal to regulate unpleasant emotional episodes: Goals and timing matter. *Emotion*, *9*, 782–797. doi:10.1037/a0017109

Wadlinger, H. A., & Isaacowitz, D. M. (2008). Looking happy: The experimental manipulation of a positive visual attention bias. *Emotion*, *8*, 121–126. doi:10.1037/1528-3542.8.1.121

Walker, W. R., Skowronski, J. J., Gibbons, J. A., Vogl, R. J., & Thompson, C. P. (2003). On the emotions that accompany autobiographical memories: Dysphoria disrupts the fading affect bias. *Cognition & Emotion*, *17*, 703–723. doi:10.1080/02699930302287

Watkins, E. R., Baeyens, C. B., & Read, R. (2009). Concreteness training reduces dysphoria: Proof-of-principle for repeated cognitive bias modification in depression. *Journal of Abnormal Psychology*, *118*, 55–64. doi:10.1037/a0013642

Watkins, E., & Moulds, M. (2005). Distinct modes of ruminative self-focus: Impact of abstract versus concrete rumination on problem solving in depression. *Emotion*, *5*, 319–328. doi:10.1037/1528-3542.5.3.319

Watkins, E., & Teasdale, J. D. (2001). Rumination and overgeneral memory in depression: Effects of self-focus and analytic thinking. *Journal of Abnormal Psychology*, *110*, 353–357. doi:10.1037/0021-843X.110.2.333

Watkins, E., & Teasdale, J. D. (2004). Adaptive and maladaptive self-focus in depression. *Journal of Affective Disorders*, *82*, 1–8. doi:10.1016/j.jad.2003.10.006

Watkins, E., Teasdale, J. D., & Williams, R. M. (2000). Decentering and distraction reduce overgeneral autobiographical memory in depression. *Psychological Medicine*, *30*, 911–920. doi:10.1017/S0033291799002263

Webb, T. L., Miles, E., & Sheeran, P. (2012). Dealing with feeling: A meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. *Psychological Bulletin*, *138*, 775–808. doi:10.1037/a0027600

Wells, T. T., & Beevers, C. G. (2010). Biased attention and dysphoria: Manipulating selective attention reduces subsequent depressive symptoms. *Cognition & Emotion*, *24*, 719–728. doi:10.1080/02699930802652388

Werner-Seidler, A., Banks, R., Dunn, B. D., & Moulds, M. L. (2013). An investigation of the relationship between positive affect regulation and depression. *Behaviour Research and Therapy*, *51*, 46–56. doi:10.1016/j.brat.2012.11.001

Werner-Seidler, A., & Moulds, M. L. (2012). Mood repair and processing mode in depression. *Emotion*, *12*, 470–478. doi:10.1037/a0025984

Whitmer, A. J., & Gotlib, I. H. (2012). Switching and backward inhibition in major depressive disorder: The role of rumination. *Journal of Abnormal Psychology*, *121*, 570–578. doi:10.1037/a0027474

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin*, *139*, 1036–1061. doi:10.1037/a0030923

Williams, A. D., Blackwell, S. E., Mackenzie, A., Holmes, E. A., & Andrews, G. (2013). Combining imagination and reason in the treatment of depression: A randomized controlled trial of Internet-based cognitive-bias modification and Internet-CBT for depression. *Journal of Consulting and Clinical Psychology*, *81*, 793–799. doi:10.1037/a0033247

Williams, J. M. G., Barnhofer, T., Crane, C., Herman, D., Raes, F., Watkins, E., & Dalgleish, T. (2007). Autobiographical memory specificity and emotional disorder. *Psychological Bulletin*, *133*, 122–148. doi:10.1037/0033-2909.133.1.122

Wilson, E. J., MacLeod, C., Mathews, A., & Rutherford, E. M. (2006). The causal role of interpretative bias in anxiety reactivity. *Journal of Abnormal Psychology*, *115*, 103–111. doi:10.1037/0021-843X.115.1.103

Yiend, J., Mackintosh, B., & Mathews, A. (2005). Enduring consequences of experimentally induced biases in interpretation. *Behaviour Research and Therapy*, *43*, 779–797. doi:10.1016/j.brat.2004.06.007